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ERRATA

Page 84 line 5 after "2 pp. refs." insert "London, 1952."

,, 90 11 lines from end for "Weid." read "Wied."

,, 94 line 20 for "DDT" read "the insecticides"

,, 106 23 lines from end for "YEOMAN" read "YEOMAN [*i.e.* YEOMANS]"

COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

REVIEW
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SERIES B.

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EDITORIAL

THE TRANSLITERATION OF RUSSIAN, SERBIAN AND BULGARIAN

In February 1953, the Royal Society published a pamphlet * containing and explaining a new system for the transliteration of the Cyrillic letters of the Russian, Serbian and Bulgarian alphabets into the English alphabet, adopted it for use in its own publications, and recommended its adoption by all bodies concerned with the citation, abstracting or indexing in English of scientific papers in which any of the three alphabets are used. This system has received wide adoption and will be used in the publications of the Commonwealth Institute of Entomology issued in and after 1954.

The new system has advantages over some of the existing ones on grounds of pronunciation, printing and indexing, and over all of them in that it provides completely unambiguous transliteration. Its freedom from ambiguity means that the reader of the transliterated word or name can know the exact spelling in the original even if he does not know the language concerned. For this reason, the practice, hitherto adopted in this *Review*, of printing authors' names in Cyrillic type as well as in transliterated form will no longer be required. If necessary, the Cyrillic letters represented by the English ones can be ascertained from the table printed overleaf, which is taken from the Royal Society's pamphlet. This table has three columns. The first shows the English letters and combinations (in English alphabetical order) and the third shows the Cyrillic letters transliterated by them. The second shows the initials of the languages (Russian, Serbian and Bulgarian) to which the transliterations apply.

* **The Transliteration of Russian, Serbian and Bulgarian for Bibliographical Purposes.**— 12 pp., 3 tables. Prepared by H. S. Bushell, M.A., with an Introduction by Sir Cyril Hinshelwood, Foreign Secretary, the Royal Society, and Sir Mortimer Wheeler, Secretary, the British Academy. London, the Royal Society, 1953. Price 1*s*.

(1484) Wt. P9/3884 3/54 E.P. Ltd. Gp. 566 [B] A

TABLE OF ENGLISH LETTERS AS USED FOR TRANSLITERATION FROM RUSSIAN, SERBIAN AND BULGARIAN

English Letters	Initials of Languages	Cyrillic Letters	English Letters	Initials of Languages	Cyrillic Letters
a	R S B	А а	p	R S B	П п
b	R S B	Б б	r	R S B	Р р
ch	R S B	Ч ч	s	R S B	С с
d	R S B	Д д	sh	R S B	Ш ш
e	R S B	Е е	shch	R	Щ щ
ë	R	Ё ё	sht	B	Щ щ
é	R	Э э	t	R S B	Т т
ê	R B	Ъ ъ	t’	R B	Ть ть
f	R S B	Ф ф	t’	S	Ћ ћ
g	R S B	Г г	th	R	Θ θ
i	R S B	И и	ts	R S B	Ц ц
ī	R	І і	t-s	R S B	ТС тс
ĭ	R B	Й й	u	R S B	У у
j	S	Ц ц	ŭ	B	Ъ ъ
j’	S	Ђ ђ	ū	B	Ж ж
k	R S B	К к	v	R S B	В в
kh	R S B	Х х	y	S	J j
l	R S B	Л л	ȳ	R	Ы ы
l’	R B	Ль ль	y̆	R	V v
l’	S	Љ љ	ya	R B	Я я
m	R S B	М м	yu	R B	Ю ю
n	R S B	Н н	z	R S B	З з
n’	R B	Нь нь	zh	R S B	Ж ж
n’	S	Њ њ	‘	R	Ъ ъ
o	R S B	О о	’	R B	Ь ь

Notes.

The use of l’, n’ and t’ in Russian and Bulgarian (where they are not transliterations of a single letter, but merely l, n or t followed by the soft sign) is included to emphasise the fact that they are used for single letters only in Serbian.

Shch and sht invariably represent the letter Щ in Russian and Bulgarian respectively, since the pairs of letters (ШЧ in Russian and ШТ in Bulgarian) seem never to occur consecutively in the respective languages.

Thompson (R. K.), Whipp (A. A.), Davis (D. L.) & Batte (E. G.). **Fly Control with a new Bait Application Method.**—*J. econ. Ent.* **46** no. 3 pp. 404–409, 4 graphs, 1 ref. Menasha, Wis., 1953.

The following is mainly based on the authors' summary. Of several methods of applying poison baits for the control of *Musca domestica* L. in dairy barns and similar places, the most effective and satisfactory was found to be the use of a garden sprinkling can [*cf. R.A.E.*, B **41** 145]. The can is filled with water, and the attractive agent (4–8 oz. per 2·5 U.S. gals.) is added to it before the poison. The attractants used included syrup, molasses, dried milk and whey; no extensive tests were made to compare them, but the most consistent results were obtained with maize syrup. The bait was best applied so as to wet the floor of the barn in irregular strips, special attention being given to areas where flies congregate. Effective control was obtained in dairies in many widely separated parts of the United States with a bait containing 0·15 per cent. γ BHC as lindane and 0·06 per cent. TEPP [tetraethyl pyrophosphate] where applications were made at intervals of two or three days. Baits containing 0·06 per cent. TEPP only were ineffective when used every two days, though they killed large numbers of flies on the day of treatment [*cf. loc. cit.*].

Treatment of the floor with the bait containing lindane and TEPP also effectively controlled the hornfly, *Siphona irritans* (L.) (*Haematobia stimulans*, auct.), if the cows remained on the treated floor for about one hour at each milking, but not if they remained for only 15–20 minutes. No control of hornflies was obtained when TEPP was the only poison in the bait.

The risks of using the bait containing lindane and TEPP are discussed. It was prepared from an emulsifiable concentrate containing 10·7 per cent. lindane and 4·3 per cent. TEPP, and it appears that the greatest danger lies in handling the concentrate and not in handling or using the diluted bait. Young calves sprayed with the concentrate diluted to bait strength showed no symptoms of poisoning, and small animals did not develop symptoms from walking on treated surfaces, even if confined on them. Samples of milk from treated dairies were analysed, and no lindane was found.

Burkhardt (C. C.) & Dahm (P. A.). **An urban Fly Control Campaign.**—*J. econ. Ent.* **46** no. 3 pp. 409–414, 18 refs. Menasha, Wis., 1953.

An account is given of a fly-control campaign carried out during June, July and August 1950 in Manhattan, Kansas. The town was surveyed in May and divided into three sections differing in sanitary conditions. They comprised a business area, a lower-class residential area and the main residential area and formed respectively 15, 10 and 75 per cent. of the total area of the town. The grill method [*R.A.E.*, B **38** 158] was used for sampling the fly population, but it is considered that reconnaissance-type surveys, in which rapid visual estimates are made every 7–10 days, give results that are as accurate as those of grill counts for all practical purposes and have the advantage of speed with corresponding saving of manpower and increase in sample size per man. *Musca domestica* L., *Lucilia* (*Phaenicia*) spp., *Phormia regina* (Mg.) and *Sarcophaga* spp. formed, respectively, 58·2, 28, 6·3 and 3·3 per cent. of the fly population. When the number of flies per block was above an empirically chosen standard (an average grill count of three flies per block at the outset and five later in the programme), chemical control measures were applied. These consisted of spraying exposed refuse, refuse bins and racks, back doors and walls of buildings along alleyways with 2·6 per cent. DDT in emulsified solution at about 1 U.S. gal. spray per 1,000 sq. ft. and a pressure of 100 lb. per

sq. inch. Grill counts from the neighbouring untreated town of Lawrence were used as a basis of comparison in estimating control. Temperature and precipitation were nearly the same in both towns. Counts were consistently higher in Lawrence than in Manhattan, but species composition in the two was very similar. Trends were similar until the third week of July, but populations in Manhattan then declined disproportionately, and it was estimated that an average of 70 per cent. control was obtained. The flies were most abundant in the business districts. The effectiveness of control was related in some degree to the species present, through differences in their resting habits. *P. regina* and *Sarcophaga* spp. were most abundant in June in both towns, and *M. domestica* and *Lucilia* spp. later in the season. Prolonged and sometimes very heavy precipitation in Manhattan often hindered spraying and reduced the effects of spray, and the spraying crew was not always available at the best time.

STARNES (E. B.) & GRANETT (P.). **A Laboratory Method for testing Repellents against Biting Flies.**—*J. econ. Ent.* **46** no. 3 pp. 420–423, 4 refs. Menasha, Wis., 1953.

The use of *Stomoxys calcitrans* (L.) and white mice for testing repellents to be employed against blood-sucking flies [*R.A.E.*, B **38** 102] has many advantages over semi-field testing with cattle or laboratory testing with flies, such as *Musca domestica* L., that do not suck blood, but the maintenance of large numbers of mice may be impracticable for many laboratories. A rapid and comparatively inexpensive screening method was therefore devised. A piece of cheesecloth saturated with a 5 per cent. acetone solution of the repellent to be tested is used to cover one end of a transparent cylinder, 2 inches in diameter and 5 inches long. Untreated cloth is placed over it. Some 15–20 individuals of *Stomoxys calcitrans* are caged in the cylinder, the other end being covered with untreated cheesecloth. To test repellency, the cage is held, treated end downwards, on the shaved belly of a rabbit, and the number of flies feeding in the time taken for 90 per cent. to feed in a control cage is observed and compared with the number feeding in the presence of a standard repellent. Tests are normally made with pieces cut from the cloth 24 hours after treatment and periodically until 50 per cent. or more of the flies feed. One rabbit can be used for 40 test cages in a day and used again within two weeks.

Comparisons showed little correlation between the ratings of the repellents in the tests against *Stomoxys* and those obtained in tests against *M. domestica* by Kilgore's method [**27** 250] and also indicated that the tests against *Stomoxys* were more selective. Thirteen of the repellents tested against *Stomoxys* in the laboratory were also applied in an oil base to cattle in New Jersey against a mixed population of *Stomoxys* and *Siphona irritans* (L.), and many discrepancies between their field and laboratory ratings were noted. In tests to ascertain the reason for this, storing treated cloths in a current of air did not change the order of effectiveness of the repellents though it reduced the duration of repellency, but discrepancies were partly accounted for by experiments with a synthetic sweat formula, the presence of which apparently enhanced the effectiveness of one repellent and decreased that of two others.

LAAKE (E. W.). **Torsalo and Tick Control with Toxaphene in Central America.**—*J. econ. Ent.* **46** no. 3 pp. 454–458, 1 fig., 2 refs. Menasha, Wis., 1953.

Toxaphene has given excellent control of both *Dermatobia hominis* (L. jr.) and *Boophilus annulatus microplus* (Can.) on cattle in Brazil where it

was first tried in 1948 [*R.A.E.*, B **38** 85–86; *cf.* also **41** 197, etc.], and investigations in other countries have confirmed that it is outstandingly effective both against the tick and against the insects that carry the eggs and larvae of *Dermatobia*. It has caused no apparent ill effect to stock when applied to cattle twice monthly for six months in 0·5 per cent. concentration [*cf.* **39** 5] or administered to cattle and sheep in feed at a concentration of 100 mg. per kg. for several months. Determination of organically bound chlorine showed that there is little danger of contamination of milk. Super-suspensible wettable powders containing 40 per cent. toxaphene are very effective and non-toxic to cattle and all other domestic animals except possibly dogs [*cf.* **37** 170]. They can be used in any type of hand or power sprayer or in dipping vats, and are cheaper than any other chlorinated-hydrocarbon insecticide that can be used safely for repeated treatment. Emulsifiable concentrates containing toxaphene may be used in dipping vats if they produce emulsions stable in all types of water.

In 1950, a campaign was begun in Nicaragua [*cf.* **41** 34] to control *Dermatobia* and *Boophilus* over an area of some 400 sq. miles by the regular use of 0·5 per cent. toxaphene in emulsified solution. The terrain was so rough that horses and pack mules had to be used for transport, and reliance had to be placed on simple and inexpensive hand-operated spray pumps. On one farm, where 846 *Dermatobia* larvae per animal were extracted from cows and calves during the nine months preceding treatment, only 41·7 per animal were found in the nine months following the beginning of spraying, and more than 82 per cent. of these were removed during the first three months. After nine months, the herd harboured less than one larva per animal and *Boophilus* had disappeared. A campaign in an area of Costa Rica containing at least 30,000 cattle was begun in 1952. Emulsifiable concentrates of the older type were generally used for spraying, but the new ones that produce stable emulsions were used in a few dipping vats at a concentration of 0·37 per cent. technical toxaphene and in sprays at 0·5 per cent. Heavily infested animals have been freed of ticks, and *Dermatobia* infestation has been reduced considerably wherever animals have been sprayed or dipped at least three times. In another area, some 2,000 cattle on one ranch have been freed of *Dermatobia* and *Boophilus* by ten treatments over a period of five months.

Chang (Shen-chin) & Crowell (H. H.). **Effect of successive Treatments of DDT on individual Susceptibility in the American Cockroach.**— *J. econ. Ent.* **46** no. 3 pp. 467–472, 11 refs. Menasha, Wis., 1953.

The effect on individual susceptibility of successive injections of suspensions of p,p'DDT at concentrations increasing in a fixed ratio was studied with nymphs of *Periplaneta americana* (L.). Each series of injections was carried out on a batch of cockroaches initially comprising ten individuals, taken at random from the stock culture, the survivors at each dosage level being injected after an interval with the next concentration. A new batch was simultaneously given this higher dosage as its first injection, thus starting a new series. In parallel experiments, different ratios of successive dosages were used, and also different intervals between injections, varying from 1 to 4 weeks. Comparisons were made, at each dosage level, between batches that had received different numbers of previous injections at the same interval between successive ones, and the difference in number of survivors between previously treated batches and the previously untreated ones was used to estimate any change in individual susceptibility. The results fairly consistently showed fewer survivors in the batch that had received the greater number of injections,

regardless of sex, of the severity of the initial treatment, of different ratios of increasing dosages or of different intervals between successive injections. Comparisons at a given dosage level showed no differences between batches that had received the same number of injections, but at different intervals between them, thus indicating that the increased sensitivity to DDT shown by these tests was induced by a physiological change in the cockroaches, rather than by the physical accumulation of the insecticide in their bodies. Control batches given ten injections, at weekly intervals, of the medium used for making the DDT suspension suffered no apparent ill effects.

STERNBURG (J.), VINSON (E. B.) & KEARNS (C. W.). **Enzymatic Dehydrochlorination of DDT by resistant Flies.**—*J. econ. Ent.* **46** no. 3 pp. 513–515, 7 refs. Menasha, Wis., 1953.

DDT-resistant house-flies [*Musca domestica* L.] have been shown to dehydrochlorinate DDT to DDE (1,1-dichloro-2,2-bis (p-chlorophenyl) ethylene) more rapidly than susceptible ones [*R.A.E.*, B **38** 209; **40** 56], and Sternburg & Kearns concluded that the resistance of a strain with which they worked could be accounted for by its abnormal ability to dehydrochlorinate DDT as fast as it was absorbed [**39** 211]. The possibility that dehydrochlorination is not the cause but simply the result of resistance has been suggested [*cf.* **41** 123], but the experiments described in this paper indicate that the resistant strain used has an enzyme system that dehydrochlorinates DDT rapidly and is absent from the susceptible strain. Crude extracts were prepared at low temperature from flies of the two strains and incubated with DDT by methods described. The extracts from the susceptible flies did not dehydrochlorinate the DDT when used under conditions believed to be near optimum for enzyme activity, but the extracts from the resistant flies dehydrochlorinated DDT in increasing amounts as the quantity of DDT was increased from 25 to 400 mmg. per 2 ml. extract (containing the equivalent of 12 flies). At present, enzymatic detoxification of DDT must be estimated from the amount of known non-toxic degradation product formed. In this case, the non-toxic product would appear to be DDE. However, as larger amounts of DDE were formed, so correspondingly larger amounts of the original DDT could not be accounted for. This might mean that DDE is a metabolic intermediate, but when DDE was exposed to the dehydrochlorinating enzyme, substantial amounts of the original compound were recovered. Alternatively, the enzymatic detoxification of DDT by resistant flies might be accomplished by means other than dehydrochlorination.

APPLEWHITE (K. H.), KEEGAN (H. L.) & HEDEEN (R. A.). **Residual Effectiveness of DDT Sprays against Mosquito Breeding in Alaska.**—*J. econ. Ent.* **46** no. 3 pp. 516–517, 1 ref. Menasha, Wis., 1953.

Collections of mosquito larvae made at Eielson Air Force Base, Alaska, in May 1951 indicated that mosquito breeding was still adversely affected by applications of DDT as a 20 per cent. solution in aromatic hydrocarbons at 0·1 lb. DDT per acre made from aircraft in previous years [*R.A.E.*, B **39** 3]. An area of 100 sq. miles was sprayed three times in 1949, once against larvae and twice against adults. A plot of 25 sq. miles in the centre of this area had been similarly sprayed three times in 1948 against adults, and it also received one additional application against adults in 1949 and three applications in 1950. This plot and the rest of the 100 sq. miles are termed the small and large plots, respectively. Counts of larvae made before the treatments in the years concerned showed 95 per cent. fewer

in the large plot in 1950 than in 1949, and 86 and 89 per cent. fewer in the small plot in 1949 and 1950 than in 1948. Counts in May 1951 showed reductions of 94·4 per cent. in the large plot and 99·9 per cent. in the small plot as compared with populations in adjacent untreated areas.

Campau (E. J.), Baker (G. J.) & Morrison (F. D.). **Rearing Stable Fly for Laboratory Tests.**—*J. econ. Ent.* **46** no. 3 p. 524, 6 refs. Menasha, Wis., 1953.

Stomoxys calcitrans (L.) has been reared in large numbers by a simplified procedure that in many respects resembles the Peet-Grady method of rearing house-flies [*Musca domestica* L.] [*R.A.E.*, B **37** 89, etc.]. The adults are kept under the same conditions of relative humidity and temperature, and the larvae are reared in battery jars in medium prepared according to the Peet-Grady procedure. Oviposition takes place in a large cage (30 × 30 × 28 ins.) containing 4,000–8,000 adults. Two dishes of food are provided daily. These are prepared by moistening a wad of cellucotton with cool tap water, squeezing it nearly dry, placing it in a porcelain evaporating dish and pouring citrated, refrigerated bovine blood over it so as almost to fill the dish and provide a relatively large free surface of blood surrounding the cellucotton. The females begin to oviposit when the level of the blood falls. The dishes are removed when fresh ones are introduced, and the eggs are transferred to a beaker, washed and put on to the surface of the larval medium at 0·3 ml. of eggs per jar. The jars are covered with muslin and left for 14 days. At the end of this time, the crust that has formed is gently removed and the pupae are loosened, and transferred to beakers, and the adults are allowed to emerge in a holding cage. The average yield of pupae per jar has been 2,240, of which 86 per cent. have produced adults.

Harrison (C. M.). **DDT-resistance and its Inheritance in the House Fly.**—*J. econ. Ent.* **46** no. 3 pp. 528–530, 6 refs. Menasha, Wis., 1953.

Work by Busvine and the author on resistance to DDT and other insecticides in strains of the house-fly [*Musca domestica* L.] from Italy and Sardinia [*cf. R.A.E.*, B **41** 122] is reviewed. Evidence was obtained that the inheritance of resistance to knockdown by DDT is explained by the occurrence of a single gene for resistance that is not completely recessive [**41** 123], but as resistance to the lethal effect of DDT was correlated with knockdown resistance in the Italian flies but not in the Sardinian ones, it appeared possible that it might be inherited by a different mechanism, and preliminary experiments have indicated that this may be so. Flies of the Italian resistant strain were crossed with normal flies and the progeny tested by the applied dose technique [**41** 122]. The chief difficulty in this type of test is to obtain enough progeny from one pair of flies to determine the resistance adequately. Four such crossing experiments yielded F_1 progeny that were very homogeneous, the resistance being approximately intermediate between those of the parent strains. Flies of the F_2 generation were considerably more heterogeneous, with large numbers intermediate in resistance, suggesting multiple-factor inheritance.

The theory that there is more than one factor concerned in resistance in the Italian resistant strain was again borne out in work by F. P. W. Winteringham, who found that both the Italian and Sardinian resistant flies converted DDT to DDE, but DDT is metabolised only very slowly and this mechanism does not therefore account for resistance to knockdown in the Italian resistant strain. He also found that the Italian strain was

resistant to 1,1-bis(p-chlorophenyl)-2-nitropropane, which cannot be dehydrochlorinated, whereas the Sardinian strain succumbed as readily as a normal strain.

WARREN (G. J.). **The Influence of Piperonyl Butoxide and DDT on the Determination of the Pyrethrins Content of commercial Spray-Insecticides by the A.O.A.C. and the Seil Methods.**—*J. Sci. Fd Agric.* **4** no. 4 pp. 180–183, 1 ref. London, 1953.

The following is the author's summary. The estimation of total pyrethrins by either the A.O.A.C. method of analysis [based on the mercury reduction method of Wilcoxon as modified by Holaday (*cf. R.A.E.*, A **37** 184)] or the Seil method [*cf.* B **38** 40] yields high results in the presence of the synergist piperonyl butoxide, or DDT. Both these compounds, on hydrolysis with alcoholic potassium hydroxide, produce acidic substances which, being apparently only slightly soluble in light petroleum and non-volatile in steam, do not affect appreciably the estimation of pyrethrins I, but, being soluble in ether, give falsely high results for pyrethrins II by either method.

MITCHELL (W.). **A new Method for Assay of the "Pyrethrins".**—*J. Sci. Fd Agric.* **4** no. 6 pp. 278–281, 13 refs. London, 1953.

The following is the author's summary. A new method for assay of "pyrethrins" is described. It is suggested that its successful operation requires less experience than do the existing methods. Comparative results on pyrethrum flowers and extracts by the new method and the A.O.A.C. (Association of Official Agricultural Chemists) method [*cf.* preceding abstract] are given. A comment is made on the standard of accuracy to be expected from pyrethrum analyses in general.

DE CASTRO (M. P.) & PEREIRA (C.). **"*Rhinoptes gallinae*" n.g., n. sp. (Acari-Sarcoptiformes: Epidermoptidae), das fossas nasais da galinha, e crítica do conceito de cohortes nos Acaridiae Latr.** [*Rhinoptes gallinae* gen. et sp. n., from the nasal Cavities of the domestic Fowl, and a Criticism of the Concept of Cohorts in Acaridiae Latr.]—*Arq. Inst. biol.* **20** pp. 67–72, 6 figs., 3 refs. São Paulo, 1951.

Rhinoptes gallinae, gen. et sp.n., is described from 12 females, four males and two nymphs taken in the nasal cavities of the domestic fowl at Curitibia, in Paraná (Brazil), in September 1946, and the difficulties of classification arising from the existing concept of cohorts in the supercohort Acaridiae are briefly discussed with reference to it.

LEES (A. D.) & MILNE (A.). **The seasonal and diurnal Activities of individual Sheep Ticks (*Ixodes ricinus* L.).**—*Parasitology* **41** no. 3–4 pp. 189–208, 6 figs., 19 refs. London, 1951.

Activity (presence at the vegetation tips [*cf. R.A.E.*, B **40** 179]) in *Ixodes ricinus* (L.) was studied by placing newly hatched larvae and newly moulted nymphs and adults in natural clumps of vegetation on a hillside in northern England in enclosures from which all hosts larger than mice were excluded. Three series were set out, in May, July and October 1945. After a period of quiescence, the ticks climbed to the active position at the vegetation tips. Activity was assessed by simple observation in the case of adults, which were marked individually, and by brushing the

vegetation with the hands in the case of nymphs and larvae, which were too small to mark. In these ways, 52 per cent. of the adults and 44 per cent. of the nymphs were recovered. Larvae became active very quickly, often within one day and usually within two months, but about a quarter of those of the October series were recovered in 1946 after overwintering in a quiescent state. There is evidence that larvae that become active in October and November may fail to survive into the following season. Nymphs became active after a somewhat longer delay than larvae, and a larger proportion overwintered. Newly moulted adults tended to remain quiescent for at least a month. Activity in the May and July series was considerable in July and August, died away in winter and was resumed in spring. In the ticks of the October series, all activity except in one individual was delayed until spring.

In 207 adults, active life was distributed over 1–6 calendar months, some of which were consecutive. Comparatively few individuals were active both before and after the winter. The average total time spent at the vegetation tips was nine days, the individual limits being one and 54 days. This activity was spread over an " active period " (interval between first and last appearances) averaging 30 days. Very active ticks rarely remained continuously at the tips. The mean number of visits to the tips was four (limits one and 19). Individuals displaying little activity remained quiescent for long and irregular periods. Where long spells of activity alternate with short periods of quiescence, the behaviour is probably regulated by the humidity reaction, the quiescent phase enabling the water balance to be restored. Analysis of results with the October series showed that in a population exhibiting normal spring activity with no hosts available, the adult spends an average of 8–10 days at the tips in 3–4 active phases of 2–3 days each. The average length of active life was five weeks.

Newly moulted adult ticks possess reserves of fat adequate for many months of quiescence. During activity, these reserves were exhausted in a few weeks or even days. Duration of survival depended mainly on whether the onset of activity was immediate or delayed. Some adults remained quiescent for a year before becoming active for the first time. Seasonal activity appears to be determined by the availability of unfed ticks rather than by weather [*cf.* **33** 165–166].

The pattern of behaviour in active ticks over a period of 24 hours was closely examined. Many remained at the tips without moving. The others began or ended a phase of activity by night or by day; but among these, the proportion ending a phase at night was significantly greater. This is the main reason for the previously reported diurnal fluctuation of activity in a tick population.

Several types of orientation were observed in the field. The most frequent and important for attaining the position at the vegetation tips favourable for meeting a host was a gravity response (upward-turning near the tip) involving both taxis and kinesis components. The tick avoids wind and direct sunlight by sheltering behind its supporting stem. The perception of eddies of warm air enables it to sense the approach of a host (represented in this work by the observer's finger). The response (questing and orientation) is elicited much less readily if the stimulus is applied from the leeward.

HEATH (G. B. S.). **The Sheep Tick,** *Ixodes ricinus* **L. Eradication by dipping Sheep.**—*Parasitology* **41** no. 3–4 pp. 209–223, 37 refs. London, 1951.

An account is given of studies on the effectiveness of various dips against *Ixodes ricinus* (L.) on sheep in Britain. An improved method of testing dips

is very briefly described; it involves daily observation to record the numbers of females that attach themselves to the sheep and the numbers that die on the sheep, disappear before engorgement, or engorge. When it is used, groups of six sheep are considered adequate for comparison of acaricides. With other methods, large numbers are needed as susceptibility to infestation varies greatly from sheep to sheep. The reason for this is not known. Commercial dips containing arsenic, cresols and grease [*cf. R.A.E.*, B **25** 219] gave excellent kill but little protection from reinfestation, and were no better than solutions of sodium arsenite in water at the same concentrations of arsenic [*cf.* **34** 184]. The addition of derris to a commercial dip [*cf.* **28** 53; **34** 183–184] did not improve it. Several coal-tar fractions were tested and proved of little value, and five finely divided inert powders examined were not acaricidal. DDT and BHC (16 per cent. γ isomer) both showed promise in controlling ticks and were about equally effective at the same concentrations, but as DDT is not effective against sheep scab [*Psoroptes ovis* (Hering)], BHC is preferred for further study. Two commercial dips containing BHC were found to be of little value. As almost all female ticks on sheep are found on the head, axillae and inguinal regions, passing the sheep through a shallow bath of dip and immersing the heads twice was tried. It gave results as good as complete immersion, was cheaper and quicker and lessened risk of percutaneous absorption of poison. Treatment of pasture with DDT aerosols by means of a Todd Insecticidal Fog Applicator appeared to have no effect on the tick population, and neither DDT nor BHC was effective against ticks when administered to sheep by mouth.

By dipping all the sheep on a pasture sufficiently often to prevent any female tick from engorging, the tick population of the pasture was almost eradicated in one year (1947). Sheep that were born in the pasture in April 1948 and remained there until October 1949 were not dipped during 1949 and are not known to have been infested at any time. Pastures from which all sheep were excluded lost their infestations gradually, but a few ticks remained at the end of three years. It is probable that almost all the ticks in the stocked enclosure attacked the dipped sheep and so were killed, whereas the lack of sheep in the unstocked enclosures caused more of the ticks to infest wild animals, so that a few were carried over from year to year. However, ridding a small area of the tick is not desirable at present, as it would cause the sheep of that area to lose their immunity from the diseases transmitted by it [*cf.* **29** 183, etc.], with the danger of epidemics if ticks were reintroduced. Also, the fact that cattle, hares and deer were absent from the test area makes the results inapplicable in many other parts of Britain. Remarks on the results of trials of coal-tar fractions and data on the amount of blood withdrawn from sheep by ticks are given in appendices.

Jones (B. M.). **The Growth of the Harvest Mite, *Trombicula autumnalis* Shaw.**—*Parasitology* **41** no. 3–4 pp. 229–248, 11 figs., 23 refs. London, 1951.

The following is substantially the author's summary. Larvae of *Trombicula autumnalis* (Shaw) were fed on mice about eight days old. They began to drop off engorged after 48 hours at 25°C. [77°F.]. The post-larval stages were reared individually in separate filter-paper cells. At 100 per cent. relative humidity, the engorged larvae were actively mobile for about 6–12 days at room temperature and for 12–20 days at 30°C. [86°F.] before they entered the quiescent pre-nymphal stage. The nymphs emerged after about 33 days at room temperature and 25 days at 30°C. from the time the engorged larvae dropped off the host.

Of the six nymphs that developed to adults, four fed on a mixture of yeast, molasses and agar plus chicken faeces, one fed on the contents that had exuded from artificially punctured eggs of *Aëdes aegypti* (L.) and one fed on a mixture of all these materials. Nymphs, whether young or old, appeared to be unable to feed on intact insects' eggs, and it was difficult to induce them to ingest the exuded contents of insects' eggs. They would not feed on chicken faeces alone, and had to be induced to feed on other media by being placed on the periphery of the food mass provided or guided to it and replaced when they moved away. Occasionally, a nymph that had been put on the food fed continuously for about 6–8 hours until completely engorged.

The features of the stages (larva, nymph and adult) are described with respect to their development and growth. The two transition or developing stages (the pre-nymph, nymphochrysalis, protonymph or nymphophane, and the pre-adult) are closed systems resembling the pupal stage of a holometabolous insect. The developing mite is enclosed by the cuticular remains of the preceding mobile stage, and a second inner or intermediate cuticle. Large flattened cells of epidermal origin are present, usually lying against the inner surface of the intermediate cuticle. Emergence of the nymph or adult depends on the combined effects of an active secretion, which causes a disintegration of the intermediate cuticle, and of muscular exertion.

Two kinds of dimorphism are shown during post-larval growth. One is a difference in size and is associated with sex. The other is confined to the nymphal stage and consists of differences in body shape and ciliation. The adults show no differences in shape or ciliation. The amount of activity shown by the engorged larva and consequent consumption of acquired food reserves seems to govern the size of the individual during post-larval life.

Laboratory findings confirm the view that only one generation is produced each year, but successive broods are produced throughout the season of incidence.

Daubney (R.) & Said (M. Sami). **Egyptian Fever of Cattle. The Transmission of *Theileria annulata* (Dzchunkowsky & Luhz 1904) by *Hyalomma excavatum*, Koch, 1844.**—*Parasitology* **41** no. 3–4 pp. 249–260, 7 graphs, 14 refs. London, 1951.

Cases of fever caused by *Theileria annulata* were observed from the end of 1946 in cattle from Cyrenaica and Cyprus and less frequently in native Egyptian cattle that were being used for experimental purposes at Abbassiah, Egypt, and the vector was shown to be the species of *Hyalomma* that Delpy classifies as *H. excavatum* Koch, which was found on some of the cattle. Investigations on its biology confirmed that it is a three-host tick in Egypt as it is elsewhere. In the autumn of 1947, large numbers of overwintering unfed adults and some engorged nymphs were located in crevices on the outside of the western wall of a brick building. They were completely quiescent and apparently resistant to desiccation. The nymphs do not moult during winter unless exposed to temperatures higher than ordinary room temperature. Adults removed from their hibernating site during winter immediately became active in the hand or in a test-tube, and hibernating adults fed successfully in each of the winter months, but they do not feed so well as they do in the summer. Whenever hibernating ticks fed on susceptible cattle, they transmitted *T. annulata*; but they have not been so fed in February or March. Cases of the disease were less frequent during January, February and March than at other times, and few ticks left hibernation sites to attach themselves to cattle nearby. Transmission reached a peak from August to November.

Experimental transmission was first effected in August 1947 and was repeated in spring 1948 with adults reared from nymphs taken on naturally infected cattle. In tests with laboratory-bred ticks, the infection was transmitted by adults infected as nymphs and nymphs infected as larvae, but not by larvae and, in one test, nymphs and adults that were the offspring of infected females and were themselves fed on susceptible cattle [*cf. R.A.E.*, B **40** 151].

Laboratory and other observations indicated that females that fed abnormally early in spring would be unlikely to oviposit until some two months later. In late March and April, the pre-oviposition period may be as short as a week and the eggs may hatch in 27 days. Larvae may feed early in May, and nymphs from late May onwards. Engorged nymphs have been taken on cattle in June, and the second moult can take place in as little as ten days during June–September. There seems no reason, therefore, why a second generation should not be completed to the engorged nymphal or fasting adult stage before the end of November.

Shute (P. G.) & Maryon (M.). **Studies in the Transmission of** *Plasmodium malariae* **by** *Anopheles* **Mosquitoes.**—*Parasitology* **41** no. 3–4 pp. 292–300, 1 fig., 15 refs. London, 1951.

Plasmodium vivax and *P. falciparum* can be maintained for long periods by passage through man and mosquito. At an English hospital where malaria therapy is practised, *Anopheles maculipennis atroparvus* van Thiel has proved an efficient vector of all strains of *P. vivax* used, including tropical ones, but whereas it was susceptible also to European strains of *P. falciparum*, it was refractory to some tropical strains. An Indian strain of the typical form of *A. stephensi* List. was susceptible to a West African strain of *P. falciparum* that failed to infect *A. m. atroparvus*. Between 1928 and 1945, transmission experiments were made at the same hospital with *A. m. atroparvus* and *P. malariae*, but though 19 batches of mosquitos were fed on people in whose blood parasites believed to be gametocytes were seen, only a few mosquitos in only six batches became infected and then with only 1–5 oöcysts. Sporozoites were never found, and none of the mosquitos transmitted the infection [*cf. R.A.E.*, B **23** 229]. Green had closely similar results, using *A. maculatus* Theo. [**18** 193], but other workers have recorded transmission of *P. malariae* by eight species and varieties of *Anopheles*. Their experiments are summarised in a table, which shows, in most cases, the percentage of mosquitos and number of patients infected, the incubation periods in mosquito and man, and the number of gametocytes per cu. mm. blood.

During 1948–50, 68 batches of *A. stephensi* were fed on patients in whose blood a strain of *P. malariae* originating in West Africa was present. Infection at least to the oöcyst stage developed in mosquitos of twelve batches. Scanty gametocytes were seen in the blood of some of the patients who infected mosquitos but not in all. Mosquitos of four of the batches transmitted the infection. Details are given of these transmissions. In one instance, a mosquito that had acquired the infection from a patient infected by mosquito bite transmitted malaria to another patient. There was evidence that either the gametocytes of *P. malariae* are transitory in the blood or they quickly lose their viability. It was not possible to determine the number of gametocytes per cu. mm. blood necessary to infect *A. stephensi*. The intrinsic incubation period varied greatly. It seems probable that several generations of the erythrocytic cycle are necessary before parasites are numerous enough to produce clinical symptoms. The character

and arrangement of the pigment in developing oöcysts of *P. malariae* are described. They are diagnostically different from those observed in all other known species of human *Plasmodium*.

SHARP (J. F.). **Adult Mosquito Control by Airspray in northern British Columbia and the Yukon.**—*Canad. Ent.* **84** no. 9 pp. 281–291, 8 figs., 3 refs. Ottawa, 1952.

Experimental area control of adult mosquitos by spraying from aircraft in June was carried out at four Air Force stations in north-western Canada during 1950. Some 3,000 gals. of 30 per cent. DDT concentrate in Velsicol AR-50 were used, diluted to 3·5 per cent. DDT with fuel oil. The spray was applied at 0·7 gal. per acre and gave a coverage of 0·23 lb. DDT per acre. The stations were Fort Nelson in British Columbia, Whitehorse and Watson Lake in Yukon Territory and Norman Wells in the North West Territory. In the first two, 11 and 11 sq. miles were treated twice, and in the last two 12 and 8 sq. miles were treated once. Treatment was carried out in the evenings or throughout the night, with a break during the short period of darkness. All the areas were well wooded and included swampy tracts in which mosquito breeding was prolific. The percentages of control effected, as assessed by counts of mosquitos at points within and outside the areas before and immediately after spraying, were 93 and 98 after the first and second applications at Whitehorse, 99 at Watson Lake and 64 and 70 after the first and second applications at Fort Nelson. Similar assessment could not be made at Norman Wells. Good control was maintained throughout the season there and at Whitehorse and Watson Lake. The first spray at Fort Nelson, applied when meteorological conditions were unfavourable, gave fair control for about two days only and the second for seven days, after which the mosquito population decreased to negligible numbers in both treated and untreated areas.

PETERSON (D. G.). **Thermal-generated Aerosols for Control of biting Flies in Canada.**—*Sci. Agric.* **32** no. 6 pp. 289–298, 19 refs. Ottawa, 1952.

The following is largely the author's summary. The investigations described show that thermal aerosols applied from a TIFA machine give effective local control of Simuliids and mosquitos of the genus *Aëdes* in forested areas of northern Canada. Under suitable meteorological conditions, a 5 per cent. (w/w) solution of technical DDT in fuel oil No. 2 or kerosene applied at the rate of 8 gals. per 1,000 feet of front in an aerosol with an average droplet size of 10–20 μ was effective over distances of at least 800 yards in dense forest. The aerosol can be applied in such areas at any time of day provided that there is an air movement of 1–3 miles per hour in a constant direction within the forest; a wind velocity of 4–6 m.p.h. above the trees is the optimum for the production of such conditions [*cf. R.A.E.*, A **36** 87]. This technique of application was effective, but not necessarily the most economical for the dispersal of aerosols; it is possible that the speed of application could be increased.

Some conclusions regarding the practicability of the Todd Applicator for large-scale control operations are drawn from the experience in its use under the varied and difficult conditions encountered during the investigations. Its large output, flexibility and ease of control are highly commendable features. It produces large volumes of aerosol with droplet spectra ranging from the smallest aerosol diameters through mists to coarse sprays. The limited demands of a mosquito-control project are thus easily met.

The large volume output is important in large-scale operations, in which economy in time and material are essential. Finally, a known and constant droplet spectrum can be produced. The size and weight of the TIFA, however, require a substantial vehicle for support and transport and passable roadways or trails, and these requirements restrict its usefulness in the forest, where there are no roads.

Miyazaki (I.). **On a new Anopheline Mosquito** *Anopheles yatsushiroensis* **n. sp. found in Kyushu, with some Remarks on two related Species of the Genus.**—*Kyushu Mem. med. Sci.* **2** no. 3 pp. 195–206, 2 pls., 6 figs., 15 refs. Fukuoka, 1951.

Anopheles hyrcanus sinensis Wied. is the commonest Anopheline in Japan and was long thought to be the only representative of the *hyrcanus* group [*cf. R.A.E.*, B **41** 116] in that country. In 1947, however, Otsuru collected a form of *A. hyrcanus* in the suburbs of Fukuoka that laid narrow-decked eggs and was subsequently identified by him as *A. h. lesteri* Baisas & Hu.

In 1948, the author collected Anophelines in Yatsushiro City where malaria had been prevalent in the past and 20 new cases had been reported in 1947. These mosquitos included some that were at first thought to be *A. h. lesteri* but are here described from adults of both sexes and eggs as *A. yatsushiroensis*, sp.n. Characters are given differentiating the adults and eggs from those of *sinensis* and *lesteri* (which are also treated as distinct species) and the eggs from those of *A. sineroides* Yam. Subsequent surveys by the author and others showed that *A. yatsushiroensis* is present at several places in the western and northern part of Kyushu and also near Kyoto in Honshu. *A. h. lesteri* was widely distributed in the northern half of Kyushu, and *A. h. sinensis* was common in all parts of the island in which surveys were made.

Larvae of *A. yatsushiroensis* have recently been found in large irrigation ditches and ponds, and it is probable that its breeding places are similar to those of *A. h. sinensis* as it is occasionally infested by larvae of the Hydrachnid, *Arrenurus* (*Arrhenurus*) *madarászi* Daday, which is a common parasite of the latter and is numerous in ponds, ditches and rice-fields [*cf.* **23** 131].

Ketterer (W. A.). **Economic Benefits of Malaria Control in the Republic of Indonesia.**—*Publ. Hlth Rep.* **68** no. 11 pp. 1056–1058. 1 ref. Washington, D. C., 1953.

Extensive campaigns begun in 1950 to destroy Anophelines in houses by spraying with DDT had protected a population of nearly a million from malaria in Java, Sumatra, Celebes and Amboina by June 1952. The ways in which the work has resulted in an increase in agricultural production, rendered new areas fit for settlement and benefited the fishing industry are briefly reviewed. One instance cited is that of the area along the Bay of Banten in north-western Java, where more than 10,000 acres of once highly productive rice land had lain idle for years as a result of destruction of the pre-war malaria-control drainage system, silting up of ditches, invasion by salt water and consequent establishment of *Anopheles sundaicus* (Rdnw.) during the Japanese occupation. House-spraying with DDT was begun in September 1951, and over 2,470 acres were again under cultivation by March 1952 and almost the whole area by autumn.

McLean (D. M.). **Transmission of Murray Valley Encephalitis Virus by Mosquitoes.**—*Aust. J. exp. Biol. med. Sci.* **31** pt. 5 pp. 481–490, 1 graph, 12 refs. Adelaide, 1953.

An outbreak of encephalitis in man occurred in the Murray Valley in Victoria and New South Wales in January–March 1951 and was found to be caused by a typical member of the group of viruses that includes those of St. Louis and Japanese B encephalitis. It was designated the MVE virus (virus of Murray Valley Encephalitis). Antibody to it was found in a large proportion of domestic fowls and wild birds in a belt 1–2 miles wide on each side of the main water-courses some months after the epidemic. As it seemed highly probable that the virus was transmitted by mosquitos, an attempt was made in the following summer to isolate it from mosquitos collected in the Mildura area, which had been heavily involved in the previous year, but the results were negative. Work was therefore undertaken to determine the Australian mosquitos that could transmit it under laboratory conditions. It was shown that five species or varieties of *Culex* and six species of *Aëdes* could carry the virus for at least ten days after feeding on a virus-blood or virus-sucrose mixture on cotton-wool. *Anopheles annulipes* Wlk., on the contrary, consistently failed to become infected. The virus was transmitted to chicks by females of *C. annulirostris* Skuse, *C. pipiens fatigans* Wied., *Aëdes occidentalis* (Skuse) and *A. vigilax* (Skuse) that had acquired it by feeding on a virus-blood mixture and by females of *C. annulirostris* and *A. vigilax* that had been infected by feeding on chicks in the viraemic phase of infection. There was a regular increase in the amount of virus in the mosquitos between the second and sixth days after infection, following an " eclipse phase ". Circumstantial evidence suggests that *C. annulirostris* was probably an important vector in the 1951 epidemic. It feeds on man and domestic fowls under natural conditions, it is a major component of the mosquito population in the Mildura area from January to March, and it is found predominantly in the riverside zone in which many birds carried antibody.

Freeman (P.) & De Meillon (B.). **Simuliidae of the Ethiopian Region.**—10 × 7½ ins., vii + 224 pp., 68 figs., 5½ pp. refs. London, Brit. Mus. (Nat. Hist.), 1953. Price £2 10*s*.

The introductory section of this monograph on the Simuliids of the Ethiopian Zoogeographical Region contains notes on the life history of Simuliids, the habits of the adults, their relation to *Onchocerca volvulus*, the distribution of various species within the Region, the structure of larva, pupa and adult, the collection, preservation and examination of material, and the problem of specific scope, together with a key to the two Ethiopian genera, *Cnephia* and *Simulium*.

The bulk of the work consists of keys to the species and descriptions of the male, female and pupa of each, where these are known, with data on distribution, material examined, synonyms and, if possible, habits. The number of species recognised is reduced from more than 100 to 69 (63 of *Simulium* and 6 of *Cnephia*). *Cnephia* is represented only from the mountains of South-West Africa and the Cape. The authors hold the view that in the genus *Simulium*, when two or more pupal types are easily derivable from each other and have identical adults or adults with inconclusive differences, they should be considered as forms of one species. They may prove, on further field study, to be sibling or incipient species. As regards classification within the genus, the authors find that the Ethiopian species do not fall into the two subgenera *Simulium* and *Eusimulium*

as defined by Edwards [*R.A.E.*, B **20** 14] and they do not recognise these for the purpose of the revision. Two main divisions based on genital characters and each subdivided into groups are proposed.

Two new species of *Cnephia* and two of *Simulium* and three new pupal forms of two other species of the latter genus are described. *S. renauxi* Wanson & Lebied [**41** 29] is considered a synonym of *S. neavei* Roub. [*cf.* **41** 63, 111], and the Simuliid tentatively identified as *S. neavei* by Grenier [**41** 49–50; *cf.* also **41** 63, 112] is described as *S. diceros* [sp.n.]. *S. nyasalandicum* De Meillon and *S. vorax* Pomeroy, which Gibbins synonymised with *S. neavei* [**25** 229; **26** 157] are differentiated as valid species. Two other Simuliids that have been confused [*cf.* **41** 147] are *S. impukane* De Meillon [**25** 2] and *S. alcocki* var. *violaceum* Pomeroy [**10** 106]. It is confirmed that the latter differs from *S. alcocki* Pomeroy only in the branching of the pupal respiratory organ, and the new name *S. alcocki* form *occidentale* is proposed for it, as *violaceum* is preoccupied by *S. violaceum* End. [**11** 138]. Gibbins accorded specific status to what he believed to be this form [**24** 276] but was in fact *S. impukane* and, owing to this misidentification, considered it to be a synonym of *S. impukane* in a subsequent paper [**26** 157].

World Health Organisation. **Insecticides. Manual of Specifications for Insecticides and for Spraying and Dusting Apparatus.**—Pagination various, illus. Geneva, 1953. Price £3.

This volume contains specifications, drawn up by the Expert Committee on Insecticides of the World Health Organisation, for technical DDT, BHC, methoxy-DDT (methoxychlor), chlordane and dieldrin, BHC containing 90 per cent. or more γ isomer, pyrethrum extract (aerosol grade), water-dispersible powders containing DDT and BHC and DDT, BHC, and dieldrin emulsion concentrates, all intended for use against vectors of diseases of man, and for spraying and dusting equipment (compression, hand and stirrup-pump sprayers, hand-activated plunger-type and rotary dusters, chemical-resistant hose, valves and hose-connections) for use in Anopheline control. Recommended standard nomenclature for types of dusting equipment and types and parts of spraying equipment is also given.

All additions and amendments to the specifications established up to at least 31st December 1955 will be made available to holders of the original volume, which is in loose-leaf form so that they may be incorporated in it.

Papers Noticed by Title only.

Anderson (A. D.) & Patton (R. L.). **Efficiency of Sulfhydril Compounds in the Detoxication of Arsenite in two Species of Insects.**—*J. econ. Ent.* **46** no. 3 pp. 423–426, 1 graph, 13 refs. Menasha, Wis., 1953. [See *R.A.E.*, A **42** 9.]

Beroza (M.). **Differential Multicomponent Spectrophotometry. Spectrophotometric Method for Determination of Benzyl Benzoate and N-Butyl Acetanilide in Clothing Impregnant M-1960** [*cf. R.A.E.*, B **40** 62].—*Analyt. Chem.* **25** no. 1 pp. 112–115, 1 graph, 10 refs. Easton, Pa., 1953.

Pope (P.). **Studies of the Life Histories of some Queensland Blattidae (Orthoptera). Part 1. The domestic Species.**—*Proc. roy. Soc. Qd* **63** pp. 23–46, 9 figs., 32 refs. Brisbane, 1953.

The following is based on the author's summary. The domestic cockroaches occurring in Brisbane are *Periplaneta australasiae* (F.), *P. americana* (L.), *P. ignota* Shaw, *Blattella germanica* (L.) and *Supella supellectilium* (Serv.). *Nauphoeta cinerea* (Ol.) is a semi-domestic species that has been found in outhouses and stores. The species of *Periplaneta* deposit their capsules within a day or two days of formation. *S. supellectilium* and *B. germanica* carry their capsules for 1–8 days and until the eggs are ready to hatch, respectively. *N. cinerea* is viviparous. The maximum numbers of capsules laid were 31 for *P. australasiae*, 68 for *P. americana*, 30 for *P. ignota*, 5 for *B. germanica*, 25 for *S. supellectilium* and 4 for *N. cinerea*, and the usual numbers of eggs per capsule were 26, 16, 24, 40, 18 and 40, respectively. The rate of development of all stages was greatly influenced by temperature, but there was also considerable variation in the rate of nymphal development among siblings. The ranges of the egg and nymphal periods in days were 39–160 and from 134–596 in *P. australasiae*, 39–99 and 134–813 in *P. americana*, 49–91 and 110–327 in *P. ignota*, 24–42 and 49–212 in *B. germanica*, and 63–156 and 90–355 in *S. supellectilium*. The nymphal period in *N. cinerea* varied from 107 to 470 days. The maximum life-spans recorded, from hatching to death, were 937 days in *P. australasiae*, 1,502 in *P. americana*, 732 in *P. ignota*, 384 in *B. germanica*, 667 in *S. supellectilium* and 1,185 in *N. cinerea*. The egg-to-egg cycles of the three species of *Periplaneta* and *N. cinerea* occupy about a year. *B. germanica* could pass through 2–3 generations in a year and *S. supellectilium* about two.

Teesdale (C.). **The Control of** *Ornithodorus moubata* **(Murray) with 0·5 per cent. Gammexane Insect Powder (D.034) at Golini, Kwale.**—*E. Afr. med. J.* **29** no. 4 pp. 138–141, 2 refs. Nairobi, 1952.

Fifty native huts at Kwale, Kenya, infested with *Ornithodoros moubata* (Murr.) were dusted in October 1949 and again in February 1950 with a powder containing 0·5 per cent. γ BHC at about 3·2 lb. powder per 1,000 sq. ft. [*cf. R.A.E.*, B **41** 130]. The October treatment caused a great reduction in numbers of ticks, the only ones found after three months being a few nymphs in two huts. The only ticks found between the February treatment and the following November were three in late May and one in July; these were in two huts. A few more adults, nymphs and eggs were subsequently seen in three huts. Tests with adults of *O. moubata* placed in cups with earth from the floors of treated huts indicated that the effects of the BHC had worn off after about 50 days. Nymphs found in treated huts after 50 days had presumably hatched from eggs laid by exposed females before death. As the eggs are resistant to BHC, two or more applications at intervals of three months may be necessary to ensure eradication in practice. The cost of BHC powder was low and this enabled some Africans to treat their own huts.

Heisch (R. B.) & Guggisberg (C. A. W.). **A Description of** *Ornithodoros erraticus* **(Lucas) from Kenya.**—*Ann. trop. Med. Parasit.* **46** no. 1 pp. 1–6, 13 figs., 4 refs. Liverpool, 1952.

Descriptions are given of the adults of both sexes, nymph and larva of *Ornithodoros erraticus* (Lucas) from examples found in burrows of pygmy gerbils (*Dipodillus*) in Kenya [*cf. R.A.E.*, B **41** 8–9]. In adult size and morphological characters, they were indistinguishable from specimens of the

small form of *O. erraticus* [**41** 193] from Morocco and Persia and were readily distinguishable from the large form from Casablanca, but the authors have received specimens from Dr. Chabaud, in Paris, most of which appear to be intermediate forms.

BERTRAM (D. S.), ROBERTS (E. W.) & EDWARDS (H.). **A rapid Method of Sampling for *Damalinia (Bovicola) bovis* L. on Cattle, and its Use in a Comparison of the Effectiveness of " Gammexane " and DDT against this Parasite.**—*Ann. trop. Med. Parasit.* **46** no. 1 pp. 7–24, 14 refs. Liverpool, 1952.

The following is based on the authors' summary. The effectiveness of BHC and DDT applied in winter against *Damalinia bovis* (L.) on cattle in Britain was investigated by sponging cows with wettable-powder suspensions at concentrations of 0·002–0·01 per cent. γ BHC or 0·01–0·1 per cent. DDT. Infestations were assessed from the numbers of lice taken on a piece of lint placed on the sacral region of the cow and covered for two minutes by a pad maintained at 30°C. [86°F.] by means of electricity.

Single treatments with 0·002 or 0·005 per cent. γ BHC were ineffective when used on stalled cows. A single treatment with 0·01 per cent. γ BHC effectively reduced heavy infestations within 24 hours to a point where no lice were found on the lint. In the absence of direct contact with other infested animals, a low-level infestation reappeared after a week and persisted for 10–12 weeks. It was derived from nymphs that hatched from viable eggs, together with a few casual survivors of the treatment. Cattle treated once with 0·01 per cent. γ BHC and kept in close contact with heavily infested animals developed considerable reinfestations within 3–4 weeks. Two treatments with 0·01 per cent. γ BHC with an interval of two weeks eradicated infestations. Treatment with γ BHC prevents most louse eggs (*D. bovis* and *Haematopinus eurysternus* (Nitzsch)) from hatching, but its effectiveness against the eggs of *D. bovis* in practice may have been reduced by the protective action of dense scurf on the skin and inadequate penetration to the bases of the hairs.

A single treatment with 0·01 per cent. DDT failed to control *D. bovis*. Treatment was followed within 24 hours by a great rise in the number of lice per sample, probably caused mainly by the increased activity induced by a sublethal dose. A single treatment with 0·1 per cent. DDT was effective, but reduction in infestations took place slowly over a week. Low-level densities then persisted for ten weeks as with BHC. DDT had no action against eggs.

BHC in water suspension applied by sponging, or even sprayed on and then massaged down to skin level, failed to penetrate evenly to the bases of the hairs. Superficial hair was more insecticidal than hair next to the skin. The sacral region of sprayed animals retained insecticidal powers longer than the sloping withers and the neck. Run-off during spraying and friction from the animal's tie-chain were probably responsible for the difference. Persistent low-level infestations for 10–12 weeks after successful single treatments with BHC or DDT are discussed. The action of deposits may play a part, but population dynamics and seasonal decline in densities [*cf. R.A.E.*, B **30** 59] cannot be disregarded. Although both insecticides at adequate concentrations control *D. bovis* successfully, the rapid kill obtained with BHC is an advantage. Cattle ordinarily in the open need be kept indoors for only one night after treatment with BHC to ensure effective kill. Two treatments by sponging with 0·01 per cent. γ BHC (and probably with 0·1 per cent. DDT) at an interval of two weeks in the late autumn or early winter should control, and possibly eradicate, *D. bovis* for the winter, provided that contact with infested animals is avoided. There was some evidence

of benefit to animals on which *D. bovis* was controlled, but this benefit may have been partly due to the fact that infestation by *H. eurysternus* was reduced. No change in milk yield was detected in successfully treated cows.

Peterson (H. O.), Roberts (I. H.), Becklund (W. W.) & Kemper (H. E.). **Anemia in Cattle caused by heavy Infestations of the blood-sucking Louse,** *Haematopinus eurysternus.*—*J. Amer. vet. med. Ass.* **122** no. 914 pp. 373–376, 7 refs. Chicago, Ill., 1953.

The effect of heavy infestation by *Haematopinus eurysternus* (Nitzsch) on the normal red blood cell volume was studied in New Mexico in three Hereford cows and a bull that were under observation for 7–34 months. Louse populations were allowed to build up unchecked on the cattle. Extremely heavy infestations produced a severe anaemia, at times reducing the red blood cell volume to such an extent that it was necessary to destroy the lice to prevent the host from dying. Destruction of the lice by means of insecticide sprays was followed by remarkable recovery, improvement sometimes being noticeable within 24 hours. Attempts to eradicate infestations failed except in one instance, when no lice were found for 4½ months on a cow treated with 0·5 per cent. chlordane emulsion. After this cow had been reinfested with about 100 lice, 174 days elapsed before the red blood cell volume had fallen to a level at which ill effects could be noticed. In a further 33 days, it fell to the lowest level recorded in the tests. When the condition of the animals became critical as a result of loss of blood, it was not materially altered by additional feed and improved care.

Shanahan (G. J.). **Fogging with DDT and BHC for the Control of Sheep Lice and Ked.**—*Agric. Gaz. N. S. W.* **62** pt. 5 pp. 229–232, 276–278, 3 figs., 1 ref. Sydney, 1951.

Shanahan (G. J.) & Wright (P.). **Fogging with BHC for Control of Sheep Lice.**—*Op. cit.* **64** pts. 2–3 pp. 65–66, 90–94, 121–122, 160–163, 3 figs., 2 refs. 1953.

Initial studies by the Commonwealth Scientific and Industrial Research Organisation indicated that insecticidal fogs were promising as a means of controlling sheep lice (*Damalinia ovis* (Schrank)) and keds [*Melophagus ovinus* (L.)], and many graziers bought fogging machines for the purpose, but further investigation was required to establish the merits of the method. Experiments were therefore carried out in New South Wales in 1950–52 in which sheep were exposed for 3–4 minutes to the fogs produced by releasing 2 gals. insecticide solution in tents with capacities of 3,375–3,600 cu. ft. The experiments in 1950 are described in the first paper, and the subsequent ones in the second. In 1950, sheep heavily infested with lice were treated immediately after shearing with either 10 per cent. p,p′DDT in dieseline or 2 per cent. γ BHC in Sovacide and dieseline. The BHC treatment was markedly superior to the DDT in reducing the louse population, but it did not eradicate the lice, and it was therefore concluded that fogging with either material was unsuccessful. No conclusion could be drawn on the value of fogging against *M. ovinus*. Both treatments, but particularly that with BHC, affected the sheep by causing violent coughing and lacrimation and an increased rate of respirative symptoms for which the solvents were probably partly responsible.

The subsequent experiments were carried out with BHC against *D. ovis* because it had seemed more promising than DDT. Lice were eradicated

from well-shorn sheep and almost eradicated from imperfectly shorn ones in 1951 by treatments, mainly in hot weather, with fogs from 2 or 4 per cent. γ BHC, having particle sizes of 30–60 or 60–90 μ and with from 125 to about 200 sheep per tent (30 × 20 ft. in area). However, there was also a marked reduction in numbers of lice on untreated sheep. The lice were not eradicated in two experiments in the cool months of 1952 when 3·3 per cent. γ BHC was used to give a fog with a particle size of 90–120 μ in a tent or at the same rate in a galvanised iron shed erected specially for fogging. Of the possible reasons for the inconsistent results in the three years, differences in treatment methods and in initial degree of infestation did not appear to be correlated with control, and it is unlikely that length of wool is a factor invariably limiting success. The weather after treatment may influence the degree of control, probably through an effect on the behaviour of the parasite or the chemical, but until further information is obtained, it cannot be concluded that temperature is the main factor involved.

Shanahan (G. J.). **Prevention of Body Strike of Sheep. An Experiment to determine the Period of Protection given by DDT and BHC.**—*Agric. Gaz. N. S. W.* **62** pts. 8–9 pp. 425–429, 481–486, 2 figs., 5 refs. Sydney, 1951. **Prevention of Body Strike of Sheep.**—*Op. cit.* **64** pt. 6 pp. 328–332, 7 refs. 1953.

These two papers comprise accounts of experiments in New South Wales on the effectiveness of various treatments for protecting sheep from body strike by blowflies. Those dealt with in the first were applied in mid-October 1950 and included jetting and spraying with 1 per cent. p,p′DDT and 0·06 per cent. γ BHC as wettable-powder suspensions and treatment in a spray-dip with γ BHC at the same concentration as a wettable-paste suspension. The jetting treatment was applied at 0·33 gal. suspension per sheep so that the wool on the upper half of the neck and body was wetted to the skin. The ordinary spray treatment was applied with a rotary garden sprayer under which groups of sheep were exposed for ten minutes, the wool around the neck and over the withers being rubbed to help penetration. The rate of application was 2 pints per head, of which about half was retained in the wool. In the spray-dip treatment, the power spray was applied from bottom and overhead rosette nozzles working simultaneously for three minutes after an interval following preliminary spraying for one minute with the spray preparation or with water, and the sheep retained 2 pints suspension per head. The value of fogging with 10 per cent. p,p′DDT, 2 per cent. γ BHC or 5 per cent. p,p′DDT and 1 per cent. γ BHC in combination was also investigated. The sheep were exposed for four minutes to a fog with a particle size of about 60 μ, produced by release of 2 gals. solution in a tent with a capacity of 2,475 cu. ft. They were much distressed by all fog treatments and particularly so by that with BHC alone.

The sheep were Merinos and had been shorn in August. All the treated groups were kept together after treatment, except for the first three weeks when the fogged sheep were kept apart from the others. One untreated group was kept with the treated sheep and another away from them. The weather was humid, but there was little blowfly activity until towards the end of the sixth week after treatment, when a severe fly wave occurred during a warm spell. As many sheep as possible were mustered and examined during the seventh week. The percentages that had body strikes were 50 and 58·6 in the untreated sheep kept with the treated ones and separate from them, respectively, and 27·3, 42 and 43 in the sheep fogged

with DDT, BHC and the mixture, whereas they were only 3·8 and 6·8 in the sheep jetted with DDT and BHC and 13 and 14·7 in those sprayed with these insecticides. The sprays would probably have been less effective if they had not been rubbed into the wool. The sheep treated in the spray-dip also had a low incidence of strike but could not be examined so thoroughly as the others.

Five further experiments, carried out between December 1950 and March 1951 with wettable powders containing DDT or BHC and emulsion concentrates containing toxaphene, chlordane or dieldrin, are described in the second paper. Sprays were applied by hand to the backs and sides of the sheep. One experiment compared spraying with 1 per cent. and jetting with 0·3 per cent. p,p′DDT and jetting and spraying with 0·05 per cent. γ BHC. The jetted sheep had received no body strikes when examined after seven weeks, and of those sprayed with DDT and BHC and untreated, 3, 1·3 and 4 per cent., respectively, were struck. Jetting was at 0·4 gal. and spraying at 0·2 gal. per head. Another experiment compared jetting at 0·33 gal. per head with 0·06 per cent. γ BHC, 0·5 per cent. toxaphene and 0·5 per cent. chlordane and spraying at 1 pint per head with 1 per cent. p,p′DDT. No treated sheep was struck on the body during the six weeks of observation, but 4·3 per cent. of the untreated sheep were struck 23 days after treatment. A third test compared spraying with two pints of 1 per cent. p,p′DDT or 0·05 per cent. γ BHC; 0·7 per cent. and none of the sheep that received these treatments, respectively, had been struck 37 days later whereas about 6·5 per cent. of untreated sheep were struck. The data from these three experiments are inadequate for definite conclusions to be drawn from them because of the low rate of body strike in the controls.

In another comparison of spraying with 1 per cent. p,p′DDT and 0·05 per cent. γ BHC, the rate of application was 1·33 pints per head, and the percentages of sheep struck on the body after six weeks were 4·9 and 14·1, as compared with 35·5 per cent. in controls.

In an experiment to compare jetting (at 4 pints per head) with 0·3 and 0·5 per cent. p,p′DDT, 0·06 per cent. γ BHC and 0·1 per cent. dieldrin and spraying (at 1 pint per head) with 1 per cent. p,p′DDT and 0·12 per cent. γ BHC, the sheep were examined eight weeks after treatment when blowflies had been troublesome for nearly two weeks. The percentages with body strikes were 13 in the controls, 12 and 10 in the sheep sprayed with DDT and BHC, 4 and 2 in those jetted with 0·3 and 0·5 per cent. DDT, and 1·1 and 0 in those jetted with BHC and dieldrin.

Du Toit (R.) & Fiedler (O. G. H.). **The new synthetic Insecticides as Dressings for Blowfly Strike in Sheep.**—*Onderstepoort J. vet. Res.* **25** no. 4 pp. 53–63, 1 fig., 7 refs. Pretoria, 1952.

Though *Lucilia cuprina* (Wied.), the most important primary sheep blowfly in South Africa [*R.A.E.*, B **41** 68, etc.], is largely dependent on living sheep for its survival, owing to competition by other species in carcasses [**33** 8, 27], it is doubtful whether the use of dressings to destroy the larvae on the sheep could ever effect a general reduction in its numbers. A treatment to protect the sheep from infestation is likely to be of more practical value [**40** 169], but it is still necessary to find a dressing that will kill or eliminate the larvae in established strikes without injuring the sheep and will prevent reinfestation. Possible insecticides for it were tested by immersing mature third-stage larvae for ten seconds in aqueous suspensions of wettable powders. A few initial tests on artificially infested sheep gave results virtually identical with those of the immersion tests. Death was often delayed until 24 hours after exposure. The percentage concentrations

that gave complete kill and (in brackets) the median lethal concentrations in parts per million were 0·1 (25) for γ BHC, 0·1 (50) for parathion, 0·4 (170) for aldrin, 0·4 (335) for dieldrin, 1·6 (335) for EPN-300 [of which the active ingredient is ethyl p-nitrophenyl thionobenzenephosphonate] and 3·2 (4,000) for chlordane. DDT, fluoro-DDT, DDD and methoxy-DDT (methoxychlor) killed 36, 64, 10 and 10 per cent. of the larvae, respectively, at 6·4 per cent., toxaphene killed 91·2 per cent. at 3·2 per cent., and malathon (No. 4049) killed 94 per cent. at 1·6 per cent., these being the highest concentrations tested.

As parathion would be dangerous to use, BHC was the most promising insecticide. The cost of using γ BHC as lindane instead of technical BHC is not justified. Various constituents of dressings were tried in patch tests on the skin of sheep with a view to finding a suitable solvent. However, only alcohol alone caused no injury, and this is too costly, as it is probable that the only advantage of using a solvent would be increased penetration of the fleece. In a comparison of two proprietary BHC emulsion concentrates with a proprietary wettable powder at three concentrations on artificially infested sheep with well established strikes, showing fairly extensive superficial erosions of the skin, healing was retarded by the emulsions but not by the suspension. All larvae were killed or driven from the fleece by all formulations at the two concentrations that were adequate (0·1 and 0·5 per cent. γ isomer).

Fiedler (O. G. H.). **The lethal Effect of some Insecticides on the B.H.C.-resistant Blue Tick,** *Boophilus decoloratus* **Koch.**—*Onderstepoort J. vet. Res.* **25** no. 4 pp. 65–67, 4 refs. Pretoria, 1952.

Because of the development of resistance to BHC in the arsenic-resistant form of *Boophilus decoloratus* (Koch) in Eastern Cape Province [*R.A.E.*, B **40** 108], *in vitro* tests were carried out to determine the susceptibility of the BHC-resistant strain to other synthetic insecticides. Larvae from eggs laid by normal ticks from the Transvaal highveldt and by BHC-resistant females from the East London area were exposed in batches of about 500 on dishes that had been sprayed with acetone solutions of the insecticides to be tested at 50 mg. per sq. ft. The times in hours taken to paralyse all larvae of a batch of the BHC-resistant strain and (in brackets) of the normal strain averaged 5 (0·167) for γ BHC, 24 (5) for α BHC, 0·5 (0·5) for p,p′DDT, 4 (2) for toxaphene, 24 (1·5) for dieldrin and 3·75 (1·5) for Ticodol (20 per cent. parathion). In preliminary tests, p,p′ methoxy-DDT (methoxychlor) and DDD both paralysed resistant larvae within 1–2 hours, whereas chlordane and aldrin took over 5 and 24 hours, respectively, to paralyse them.

Nelson (W. A.). **A Note on the Presence of first-stage Larvae of** *Gasterophilus intestinalis* **(Degeer) (Diptera: Gasterophilidae) in the Mouth of the Horse.**—*Canad. Ent.* **84** no. 11 p. 356, 6 refs. Ottawa, 1952.

First-stage larvae of *Gasterophilus intestinalis* (Deg.) have been stated to develop in the mucosa of the tongue, cheeks and lips of horses [*R.A.E.*, B **22** 70; **23** 105; **26** 152] and those of *G. nasalis* (L.) between the molar teeth below the gum line [**29** 45–46], where they cause necrosis resulting in the formation of pus pockets. In studies in Saskatchewan, *G. intestinalis* also was found in pus pockets between the teeth. During autopsy of several horses in August–November 1948, 72 first-stage larvae, 3 larvae in transition stages and 16 early second-stage larvae of *G. intestinalis* and 22 first-stage and 9 second-stage larvae of *G. nasalis* were identified from such

pockets. The largest number of larvae taken from one pocket was 30. First-stage larvae of *G. intestinalis* were also taken from the mucosa of the tongue, and only occasionally from cheeks and lips. *G. nasalis* was not identified from the cheeks.

Cragg (J. B.) & Cole (P.). **Diapause in *Lucilia sericata* (Mg.) Diptera.**—*J. exp. Biol.* **29** no. 4 pp. 600–604, 1 fig., 12 refs. London, 1952.

It is well established that unfavourable conditions, such as cold or excessive moisture, acting directly on larvae of *Lucilia sericata* (Mg.), may induce diapause in them [*cf.* also *R.A.E.*, B **27** 83], but one of the authors observed during several years' work in Britain that many of the larvae collected in the field towards the end of the blowfly season entered diapause in spite of completing their feeding period under laboratory conditions favouring pupation, and Cragg & B. A. Thurston in 1949 found that egg batches from wild flies caught in late summer gave a high proportion of diapausing larvae even under conditions favouring normal development. These observations and the fact that larvae infesting sheep would be in a favourable environment even in autumn suggested that diapause might be of maternal origin, and the hypothesis was tested in 1950–51.

Females caught in the field were induced to oviposit on various dates between 20th July and 19th October, and the behaviour of their larval progeny was compared with that of the progeny of control flies from a laboratory culture ovipositing at the same time. A batch was considered normal if 50 per cent. of the larvae pupated within 14 days of completion of feeding, and diapausing if less did so. The total numbers of females giving normal and diapause batches, respectively, were 122 and 71 of the field flies and 176 and four of the controls, and the percentages of diapause batches and of diapausing larvae per batch both increased in the progeny of the field flies as the blowfly season approached its end in each year. Tests with laboratory flies showed that the age of females had no significant effect on the amount of diapause in their progeny. The capacity to give diapausing batches was lost by most field flies after they had been kept under standard laboratory conditions for 10–16 days. However, two out of 14 flies of which the first egg batches were normal subsequently gave diapausing batches. There was no obvious correlation between fluctuation in percentage pupation and any one weather measurement. The occurrence of maternally induced diapause in *L. sericata* and perhaps in other blowflies overwintering in the so-called prepupal state ensures that most larvae produced at the end of the blowfly season enter diapause in spite of the possible chance occurrence of ground conditions favouring pupation.

Thompson (B. W.). **Aircraft Applications of Insecticides in East Africa. III. Atmospheric Turbulence in Woodland.**—*Bull. ent. Res.* **44** pt. 4 pp. 611–626, 7 figs., 8 refs. London, 1953.

Hocking (K. S.), Parr (H. C. M.), Yeo (D.) & Anstey (D.). **IV. The Application of coarse Aerosols in Savannah Woodland containing the Tsetse Flies *Glossina morsitans* and *G. swynnertoni*.**—*T. c.* pp. 627–640, 4 figs., 6 refs.

An account is given in the third part of this series, the first two of which have already been noticed [*R.A.E.*, B **41** 211], of an attempt to determine the conditions of air motion that would allow of optimum distribution and persistence of an insecticide aerosol within natural African woodland of a density that would support a high population of *Glossina*. Notes are first

given on atmospheric turbulence and its assessment, with a brief description of the recording apparatus used. Conditions in tsetse bush are not likely to be simple, because the canopy is neither thick nor continuous, particularly during the leafless period most suitable for applying insecticides from aircraft. The relevant factors pertaining to atmospheric turbulence were observed in July and September 1951 in an area of woodland with moderately dense canopy, allowing sunlight to penetrate to some 30–40 per cent. of the ground. In some cases, direct comparisons were made with simultaneous observations in the open.

The principal reduction in wind speed was at canopy level. The effect of winds of typical East African strength above the woodland was to create light but irregular air movements inside it, with a tendency towards decreasing speed with decrease in height. With light winds outside the bush, air movement inside was slight, but there was seldom absolute calm. The absence of zero wind speeds, considerations of changing lapse rates, the records of bi-directional wind vanes and visual observations of smoke all suggested that when winds in the free air are calm or light there is an almost continuous and slow transfer of air between the canopy and the ground by day and night under moderately dense woodland canopies, and these movements tend to be laminar or sheet flows, and give widespread dissemination and slow diffusion of introduced insecticides. The extent of dissemination and diffusion also depends on the settling properties of the droplets used, a high density of very small droplets being the most desirable. Insecticide applications from the air, relying on sedimentation, are likely to give a high degree of saturation of woodland in non-turbulent atmospheric conditions, provided that the canopy is not so dense that the insecticide cannot penetrate it. Insecticides applied from the ground under moderate canopies and in non-turbulent atmospheric conditions should be just as effective as those applied from aircraft, and under very dense canopies might well be more so. With very light canopies, there is a danger that insecticide clouds from the ground would not reach the tops of the trees, unless jet nozzles or a considerably heated source were used, and then probably only near the point of emission. Under these conditions, the air movements, which result from differential heating or cooling between canopy and ground, become very slight, and aircraft applications relying on sedimentation are particularly valuable.

With stronger winds, eddying about the trees causes the air motion to be erratic and turbulent, particularly if the canopy is light. Applications of insecticide from aircraft is normally impracticable during most of the tropical daytime, owing to turbulent diffusion of the insecticide as soon as it is released, but application from the ground might give satisfactory results under dense or very dense canopies, where the turbulence tends to be sluggish. Clearings and thin patches, however, would reduce insecticide efficiency by causing rapid diffusion.

The fourth part comprises an account of attempts made in 1949 to eradicate *Glossina morsitans* Westw. and *G. swynnertoni* Aust. from two blocks of savannah woodland in the Central Province of Tanganyika, with insecticides applied from aircraft. The area is described. Coarse aerosols were used, with droplets having diameters of about 4–250 μ and a mass median diameter of about 90 μ. One block was treated with DDT and the other with BHC. Eight applications of insecticide were made at intervals of about two weeks during the latter part of the dry season to cover rather more than two pupal periods. Most of the trees were leafless and the ground was hard and dry. Each application was at a nominal dosage of 0·25 gals. per acre of a 10 per cent. w/v solution of technical DDT or crude BHC, equivalent to 0·2 lb. per acre p,p′DDT or 0·03 lb. per acre γ BHC.

Previous work had suggested that the insecticides would be about equally effective at these rates. In the area treated with DDT, where *G. morsitans* was predominant, some zero catches were recorded during the eight weeks after the last application, and it is possible that both species were eradicated for a short time; populations during the next 13 months were small, and there was evidence that they were established by immigrant flies. In the area treated with BHC, where *G. swynnertoni* was predominant, control was less complete. During January and February 1950, 3–4 months after the last application, apparent densities (numbers of non-teneral male flies caught per 10,000 yards of fly path) of *G. morsitans* and *G. swynnertoni* were 9 and 12 per cent., respectively, of their pretreatment values. Populations did not increase during the following two years. The incomplete kill is attributed to circumstances that led to less thorough applications and not to a difference in effectiveness of BHC and DDT. Some general observations are made on the use of aircraft for the kind of work under discussion, particularly the bearing of meteorological conditions on efficiency.

Nowosielski-Slepowron (B. J. A.). **An Experiment on the Control of Tsetse** (*Glossina palpalis* **R.-D.) in high Forest of West Africa.**—*Bull. ent. Res.* **44** pt. 4 pp. 703–710, 2 figs., 4 refs. London, 1953.

Extensive building on the ridges near Kumasi, Gold Coast, is leaving potentially dangerous isolated habitats of tsetse flies (including *Glossina palpalis* (R.-D.), *G. pallicera* Big. and *G. nigrofusca* Newst.) in the valleys between them. Contact between man and fly may be considerable along roads and paths and around the periphery of the uncut bush, and the presence of large numbers of itinerant labourers and traders who may be infected with sleeping sickness (*Trypanosoma gambiense*) increases the danger involved. The vegetation of the valleys is of semi-deciduous rain-forest type, with very thick secondary bush where farms have been abandoned. K. R. S. Morris devised and initiated the scheme here described for banishing *Glossina* from these foci by discriminative clearing. In the Dechem valley, the first to be dealt with, all vegetation up to 20 ft. high in a strip of bush 250–300 yards wide along the stream was cut, the stumps dug out and the whole burnt between July 1950 and March 1951. Effectiveness was assessed from catches in 20 traps [R.A.E., B **37** 110] arranged in groups of 2–4. The catch in each group of traps fell gradually after bush was cleared in its neighbourhood, and the extension of clearing to other valleys with similar vegetation associations was deemed to be justified. A plan designed to eliminate in five years all isolated foci of *Glossina* between Kumasi and existing housing estates or those soon to be built was accordingly made, and about one-sixth of it had been completed when this paper was written. The *Glossina* populations had been reduced by at least 80 per cent. in most cases, and they had been eliminated in the Kedjetia valley, potentially one of the most dangerous isolated habitats. The cost of clearing an acre ranged from £14 10s. to £25. The cleared valleys were rapidly used for cultivation or amenities. Clearing was also carried out successfully at the Regional College of Technology, and although the area is surrounded by an extensive habitat of *Glossina*, a reduction of 90 per cent. was estimated by fly-round and trap records.

Wilson (S. G.). **The Control of** *Glossina palpalis fuscipes* **Newstead in Kenya Colony.**—*Bull. ent. Res.* **44** pt. 4 pp. 711–728, 1 pl., 9 figs., 5 refs. London, 1953.

In Kenya, *Glossina palpalis* (R.-D.) is firmly established along the shore of Lake Victoria and extends many miles inland along the main rivers

[*cf. R.A.E.*, B **24** 86] to an altitude of at least 4,700 ft., breeding up to 4,500 ft. The measures used against it have been hand-catching and total or discriminative clearing of the bush on the river banks. Hand-catching was sometimes successful [**25** 165; **36** 67], but it was often too expensive, and it was not applicable to areas where riverine stretches of convenient size could not be isolated [**39** 189]. Accounts are given of bush clearing carried out on a relatively large scale along three main rivers, the Yala, the Magori and the Nyando, and the Mbogo, Ainamotua and Gundas tributaries of the Nyando river system. It was often unsatisfactory unless the land could be burnt over immediately, and this is not always possible in an area of very erratic rainfall. Moreover, the method is very costly, particularly as the river banks in question are largely infertile and unsuitable for settlement so that maintenance presents a serious problem.

Treatment of riverine growth with DDT was therefore tried. It was used at a concentration of 5 per cent. in sprays prepared from a paste or emulsion concentrate and applied by men who walked along the river bed and sprayed all vegetation that could be reached with their knapsack pressure sprayers. Vegetation on both banks of the Mbogo for 20 miles was sprayed four times between February and May 1951 with 13·8 lb. DDT per mile per application. This would have been equivalent to 10 lb. per acre if the spray had been applied evenly to a depth of two yards on each bank, but as the vegetation varied greatly in depth and composition up to 15–20 lb. per acre was applied on the most heavily infested foci. The treatment gave very promising results, but one treated block was constantly reinfested from the Ainamotua, which ran within a few hundred yards for almost a mile. Treatment was therefore extended to include this river also, and at the same time the system of spraying along the entire length of the original stretch was largely abandoned in favour of spraying smaller localised areas where fly were still being caught. Details are given of the distances sprayed and amounts of DDT applied per acre. *G. palpalis* was eradicated from the originally treated blocks by May 1952 at a cost of £42 per mile. Clearing, on the other hand, had cost between £200 and £300 per mile. Deposits of DDT retained their effectiveness for at least 14 days during dry weather, but lost it rapidly during the rains. The work on the Ainamotua presented many practical difficulties, and original treatments were not so heavy or so frequent as on the Mbogo. The initial decrease in catches of *G. palpalis* was therefore less rapid and spectacular, but catches in the blocks first treated decreased from 746 in June 1951 to 5 in June 1952, and over the whole 37 miles of the river eventually included, they decreased from 929 in August 1951 to 17 in June 1952. This reduction (from about 25 to 0·5 flies per mile) is considered very promising, and perseverance with the work until eradication is achieved and then extension until the whole Nyando river system has been dealt with is considered desirable.

Busvine (J. R.) & Harrison (C. M.). **Tests for Insecticide-resistance in Lice, Mosquitos and House-flies.**—*Bull. ent. Res.* **44** pt. 4 pp. 729–738, 1 fig., 8 refs. London, 1953.

Between December 1947 and May 1949, six colonies of *Pediculus humanus humanus* L. (*P. h. corporis* Deg.) from various sources were cultured in England in the laboratory on the human leg. Three of the strains originated from natural infestations in England, and the others came from laboratory cultures in Hamburg, Basle and Tunis. After the strains had been bred for at least one generation in the laboratory, lice from each were exposed to standard DDT-impregnated fabrics to test their resistance, if any. Only the strain from Tunis showed evidence of abnormal resistance. This strain

had been maintained in the laboratory there for about 12 years, and in tests with three successive generations, its resistance varied significantly from one generation to the next.

Colonies of *Aëdes aegypti* (L.) from Karachi, Poona and Delhi, which were being maintained at a laboratory in Lagos, were compared with a local Nigerian strain for resistance to DDT by Busvine in 1952. Extensive tests in which the mosquitos were exposed for one hour in filter-paper cylinders impregnated with oil solution of DDT [*cf. R.A.E.*, B **41** 156] showed no difference in the average susceptibility of the four strains, though there was a significant difference between the Karachi and Nigerian strains in the extent of variation in susceptibility. Comparative tests also showed no difference in susceptibility to γ BHC between a laboratory culture of *A. aegypti* at Lagos and a colony started with larvae from Ilaro, a Nigerian town in which all the houses had been sprayed with BHC (10–15 mg. γ isomer per sq. ft.) every three months for 2½ years.

In 1952, Busvine also compared the susceptibility to insecticides of four strains of house-flies of which colonies were maintained at Lagos on monkey faeces as oviposition medium and larval food. They comprised a normally susceptible strain of *Musca domestica domestica* L. from England, strains of *M. d. vicina* Macq. and *M. sorbens* Wied. from Yaba, near Lagos, and a strain of *M. d. vicina* from Ilaro. The flies were treated individually with drops of oil solution of insecticide applied dorsally. On the basis of median lethal concentrations, Yaba *vicina* was somewhat more susceptible to γ BHC and dieldrin and *sorbens* was considerably more susceptible to γ BHC and DDT than was *domestica* from England. These differences could be explained by the smaller average sizes of the two susceptible strains. On the other hand, each of the *vicina* strains was 5·4 times as resistant to DDT as English *domestica*, although no DDT had been used at Ilaro and little, if any, in Lagos. Ilaro *vicina* was 11·4 times as resistant to γ BHC and nearly twice as resistant to dieldrin as Yaba *vicina* and 5·7 times as resistant to γ BHC as *domestica* from England.

Hornstein (I.) & Sullivan (W. N.). **Determination of Lindane in Air.**—*Analyt. Chem.* **25** no. 3 pp. 496–498, 6 refs. Easton, Pa., 1953.

The authors describe a method of determining small amounts of lindane [virtually pure γ BHC] in air, by which concentrations as low as 0·1 mmg. per litre can be measured. It is of practical importance because of the extensive use of lindane vapour for insect control, and the fact that it measures all isomers of BHC does not introduce an error, because the lindane is always vaporised alone.

An air sample is drawn through gas-washing bottles containing acetic acid or through an alumina adsorption column, from which the adsorbed lindane is washed with acetic acid. The second process is the more practical, requiring a minimum of equipment and time, and gives results that are precise and in agreement with those obtained by the first method. The quantity of lindane is determined by an adaptation of a colorimetric method, in which the compound is dechlorinated to benzene and this nitrated to m-dinitrobenzene, which, after extraction, is allowed to react with methyl ethyl ketone in the presence of strong alkali; the violet-red colour that develops is measured photometrically, and the BHC determined from a calibration curve prepared from a standard glacial-acetic-acid solution of lindane.

It is concluded that under optimum conditions, the concentration of lindane in air can be determined with a precision of about ± 2 per cent. Air can be sampled at the rate of 0·2 cu. ft. per minute. In an enclosed

space, with very little air interchange, lindane concentrations of about 90 per cent. saturation, as calculated from known vapour-pressure measurements, were found.

Berck (B.). **Microdetermination of DDT in River Water and suspended Solids.**—*Analyt. Chem.* **25** no. 8 pp. 1253–1256, 3 graphs, 12 refs. Easton, Pa., 1953.

The following is the author's summary. DDT in river water (as low as 0·003 p.p.m. of DDT) and in suspended solids was determined, using solvent extraction and the Schechter-Haller procedure [*cf. R.A.E.*, B **35** 196]. Interferences in the extract were removed by Davidow's chromatographic method. It was found that solids suspended in river water (clay, silt, very fine sand) adsorbed DDT. In samples containing suboptimal amounts of DDT, for which the regular solvent extraction of water was not feasible, DDT was determined directly from the suspended solids fraction. Larger samples of water may thus be processed with gain in sensitivity.

Konecky (M. S.). **Report on Allethrin.**—*J. Ass. off. agric. Chem.* **36** no. 2 pp. 388–390, 3 refs. Washington, D.C., 1953.

The author gives details of two methods that are being developed for the analysis of technical allethrin, which as now produced commercially contains 75–96 per cent. allethrin, consisting of eight optical and geometrical isomers [*cf. R.A.E.*, B **40** 116–117]. The hydrogenolysis method depends on the cleavage of an ester of a β-unsaturated alcohol to yield free acid, which is then determined by titration, and the ethylenediamine method on the splitting of allethrin to give the ethylenediamine salt of chrysanthemum monocarboxylic acid, which titrates as an acid with standard sodium methylate in a pyridine medium. These titrations measure the gross allethrin in the samples, and suitable corrections must be applied to obtain the net allethrin content. It is recommended that both methods should be investigated further.

de Zulueta (J.). **Observations on Mosquito Density in an endemic malarious Area in eastern Colombia.**—*Amer. J. trop. Med. Hyg.* **1** no. 2 pp. 314–329, 2 figs., 15 refs. Baltimore, Md., 1952.

The observations described were made in November 1949 and May–August 1950 in a small rural settlement typical of areas of endemic malaria in the savannah country of eastern Colombia. The district is characterised by forest galleries intersecting the savannah, and the rainy season, during which rainfall is heavy, lasts from April to the end of November. The object of the work was to compare the numbers of Anophelines in houses with their density in the savannah. The houses were mere shelters consisting of palm-thatch roofs supported on poles; some had no walls and the others had walls that did not reach the roof. Catches in them were made by taking females in test tubes as they came to bite between 6 and 9 p.m., the time of greatest activity. Density in the savannah was measured by the methods described in a previous report [*R.A.E.*, B **40** 195], but to facilitate the collection of mosquitos resting in grass a light portable cage of aluminium and gauze on a wooden frame was substituted for a tent. It covered about $3\frac{1}{2}$ sq. yards of ground and was high enough for a man to work upright inside it.

Nearly 98 per cent. of the mosquitos taken in houses were Anophelines, and *Anopheles darlingi* Root, the chief malaria vector of the region [*cf.* **40**

85], and *A. pessôai* Galvão & Lane comprised 70 and 27·5 per cent. of the latter. *A. darlingi* increased in abundance from 6 until 9 p.m. *A. pessôai* was most active between 7 and 8 p.m. No Anophelines were found resting in the houses during the day. *A. darlingi* showed a clear preference for man when given the choice, under identical conditions, between man, donkey, and calf, and it could detect a bait from a greater distance than the other Anophelines, so that the small clearings that the people make round their houses were ineffective against it. *A. argyritarsis* R.-D. was but slightly attracted by man and was easily deterred by grass clearings. The behaviour of *A. pessôai* was intermediate.

In the savannah, *A. pessôai* was much the most abundant Anopheline and *A. argyritarsis* was considerably more plentiful than would have been expected from the house catches, whereas *A. darlingi* had a very low density. Anophelines formed less than 10 per cent. of the mosquitos resting by day in the grass and 17·6 per cent. of those caught in the evening in nets fixed to a moving vehicle. Mosquito density within about 100 yards of houses was about the same as in the open savannah 500 yards from any dwelling, but the proportion of Anopheline females was higher near the houses. Though the sample was small, this seems to indicate that female Anophelines that come to dwellings tend to rest near them. Engorged females of all mosquitos were more abundant near houses than away from them.

Komp (W. H. W.). **The facultative Breeding of** *Haemagogus spegazzinii falco* **Kumm et al., the Vector of Jungle Yellow Fever in Colombia.**—*Amer. J. trop. Med. Hyg.* **1** no. 2 pp. 330–332, 7 refs. Baltimore, Md., 1952.

Great difficulty has been experienced in finding the breeding places of *Haemagogus spegazzinii falco* Kumm, Osorno & Boshell, the vector of yellow fever in eastern Colombia [*R.A.E.*, B **37** 26, 27], in numbers sufficient to account for the abundance of the adults in the forest canopy [*cf.* **32** 184; **39** 212]. An examination of probable breeding places in high rain forest near Villavicencio in 1944 by the author and M. Bates, including some tree-holes at least 50 ft. from the ground, yielded no larvae of *Haemagogus*. However, in the early summer of 1935 the author had found larvae now known to be those of *H. s. falco* in large numbers near Villavicencio in holes in stumps and felled trees and in cut bamboo stems and a depression at ground level formed by the rotting out of a palm stump. Some years later, he collected larvae of *H. spegazzinii* Brèthes from cut bamboo at ground level near Port of Spain, Trinidad. It is thought that in both cases females had taken advantage of abnormal conditions in the absence of natural breeding places near a plentiful source of human blood. Such conditions must be common near many small towns in Colombia and Brazil and may be potentially very dangerous with regard to the transmission of sylvan yellow fever.

Sabrosky (C. W.). **House Flies in Egypt.**—*Amer. J. trop. Med. Hyg.* **1** no. 2 pp. 333–336. Baltimore, Md., 1952.

During investigations at Cairo in June and July 1950, the author determined that 11 species or subspecies of *Musca* occur in Lower Egypt. Special attention was given to variation in their taxonomic characters with particular reference to the classification of the various forms of *M. domestica* L. which are considered to include *M. nebulo* F. and *M. cuthbertsoni* Patt. (provisionally regarded as subspecies). The chief characters by which the members of the *domestica* complex have been distinguished are the length

of the postsutural dorsocentral bristles and, in the males, the width of the front between the eyes. The front is broad in *M. d. domestica*, intermediate in *M. d. vicina* Macq., and narrow in *M. d. nebulo* and *M. d. cuthbertsoni*, while the bristles are long in the first three, whereas *cuthbertsoni* has short anterior postsuturals.

All members of the complex found by the author in Egypt were considered to belong to populations of two forms, *vicina* and *cuthbertsoni*, though *nebulo* and typical *domestica* have previously been recorded there. Examination of series reared from eggs laid by isolated females showed that long-bristled females (*vicina*) consistently produced long-bristled offspring, but short-bristled females (*cuthbertsoni*) had progeny that ranged from very short-bristled to very long-bristled individuals. Bristle length cannot therefore be used as an absolute criterion in identifying individuals. Progeny of *vicina* and *cuthbertsoni* overlap slightly in certain combinations of characters, but there may be two distinct populations in nature, and the normal curves of distribution of characters of the two may overlap for only a small percentage of individuals. Geographical and seasonal distribution may provide further evidence that *cuthbertsoni* is a natural population distinct from that of *vicina*. So far, *cuthbertsoni* has been regarded as typically a species of the Ethiopian Region. Occasionally, male offspring of *cuthbertsoni* females showed the combination of narrow front and long bristles, and in museum collections would be identified as *nebulo*. This is thought to account for the recording of *nebulo* from Egypt. No populations of *M. d. domestica* were found in Egypt, but two males with the habitus of typical *domestica* were collected at Alexandria. However, progeny of females of *vicina* included occasional males with the characteristically broad front of typical *domestica*, so that the occasional finding of such individuals does not prove the presence of the typical form in Egypt. Earlier records may be based on variant examples of *vicina* or on introductions.

At the time of the study, *M. d. vicina* was much the most abundant form in Cairo and Alexandria and was the common fly in most of the villages of the Nile delta from which samples were examined. *M. d. cuthbertsoni* was predominant in a few places, common in a few and occurred occasionally in others. *M. sorbens* Wied. was widespread but apparently not abundant, and other members of the genus were infrequently found. *M. d. vicina* and *M. d. cuthbertsoni* were characteristically domestic in habit and were plentiful in cafés, bazaars, abattoirs, food stores and houses. *M. sorbens* was sometimes present in these places in small numbers and was more directly annoying to man than the other two. The flies bred from three samples of human faeces from a village near Cairo comprised one example of *vicina*, 833 of *sorbens* and 386 of *Sarcophaga* spp., whereas five lots bred from animal rooms, compost heaps and latrines comprised 815 of *vicina*, 20 of *cuthbertsoni*, 53 of *Sarcophaga* spp. and only nine of *sorbens*. Fuel cakes have been suspected of producing numerous house-flies [*cf. R.A.E.*, B **40** 205], but eight samples from the village yielded only 29 individuals of *M. d. vicina* and four of three uncommon species of *Musca* together with 399 flies of other genera.

Janssen (W. A.) & Wedberg (S. E.). **The common House Roach,** *Blattella germanica* **Linn., as a potential Vector of** *Salmonella typhimurium* **and** *Salmonella typhosa*.—*Amer. J. trop. Med. Hyg.* **1** no. 2 pp. 337–343, 13 refs. Baltimore, Md., 1952.

Controlled feeding experiments carried out with adults of *Blattella germanica* (L.) mounted on wax blocks [*cf. R.A.E.*, B **41** 188] are described. Individuals fed exclusively on molar sucrose solution lived for an average

of about 50 days, and one female lived for 205 days. Broth of beef-heart infusion or a mixture of skim milk, 1 per cent. yeast extract and 0·5 per cent. sucrose maintained life for long periods, but not for so long as the molar sucrose solution. All diets were autoclaved. A list is given of the aerobic and facultative bacteria found in the faeces and alimentary canal of 13 control cockroaches. No determinations were made of anaerobic flora. When *Salmonella typhimurium* was given to individual cockroaches in sufficient numbers, positive faecal cultures were obtained up to ten days after feeding, and the contents of the alimentary canal harboured viable organisms after up to 18 days. After single feeds of a broth culture of *S. typhosa* containing between 3 million and 38 million organisms, 21 adults produced only two positive faecal specimens out of 45 examined over a period of 11 days. Both were passed within 18 hours of feeding. Only one alimentary canal was positive. This was on the second day after culture. Chance contamination cannot be overlooked. In further tests in which cockroaches were allowed to feed to satiety on a heavy suspension of *S. typhosa* and were killed at intervals of three hours, positive cultures were obtained for 12 hours but not longer. None of the tests carried out revealed the presence of any lethal agent responsible for this mass destruction of *S. typhosa*.

Mer (G. G.) & Furmanska (W.). **The Effect of the Fat Content in the Fly Food on the Resistance to D.D.T.**—*Riv. Parassit.* **14** no. 1 pp. 49–54, 2 refs. Rome, 1953. (With a Summary in Italian.)

An account is given of experiments with a laboratory strain of *Musca domestica vicina* Macq., in which batches of flies (males or both sexes) were exposed to DDT after having been fed on skimmed or whole milk with or without the addition of butterfat or groundnut oil. The rates of knockdown were considerably lower in the flies given additional fat than in the others, and the times required for 50 per cent. knockdown were longer. Contamination with butterfat of flies that did not feed on it did not influence their sensitivity to DDT.

Livadas (G.). **Is it necessary to continue indefinitely DDT residual spraying Programmes? Relevant Observations made in Greece.**—*Riv. Parassit.* **14** no. 1 pp. 61–66, 13 refs. Rome, 1953. (With a Summary in Italian.)

In view of the successful control of Anophelines and consequently malaria obtained in certain areas of Greece in 1945 by spraying all premises with DDT [*R.A.E.*, B **37** 11–12], this measure was applied annually during 1946–50 throughout the rural areas of the country in which malaria was endemic and so protected a population of over 3·4 million. The parasite rate in infants, estimated each autumn, fell to 0 within the first year and was maintained at 0 during the five years. The parasite rates for children of school age fell to 0·04 and 0·03 per cent., respectively, in 1949 and 1950. In 1951 and 1952, the spraying was discontinued entirely in Crete and almost entirely in the Peloponnese, and was greatly reduced in the other parts of Greece; the total number of villages sprayed fell from an annual average of over 5,000 in 1946–50 to less than 2,000 in 1951 and less than 400 in 1952. Despite this, there were no cases of malaria in Crete and no significant rise in the numbers of cases elsewhere. Anophelines did not increase in numbers in Crete, but increased in some places on the mainland, and spraying was resumed in a few villages where Anopheline density or the occurrence of a few cases of malaria indicated the need for it. This

spraying was ineffective in one area (Scala-Laconia) of the Peloponnese in 1952 because of acquired resistance to DDT in the local vector, *Anopheles maculipennis sacharovi* Favr, but there was no indication of a recurrence of endemic malaria there.

The absence of any outbreak of malaria in 1951–52, even where Anophelines increased, is attributed to its virtual elimination by the five years' campaign. A temporary suspension of the campaign, continued only for so long as its effect on malaria persists, would not only effect a considerable saving of expense, but also prevent the local Anophelines from acquiring resistance to insecticides.

STAGE (H. H.), GJULLIN (C. M.) & YATES (W. W.). **Mosquitoes of the Northwestern States.**—*Agric. Handb. U.S. Dep. Agric.* no. 46, [1+] 95 pp., frontis., 39 figs., 8 maps, 175 refs. Washington, D.C., 1952.

In this handbook, widely scattered data on the 39 species and subspecies of mosquitos recorded from Oregon, Washington and Idaho are assembled. The first half comprises general sections and includes information on literature, the general characteristics and habits of mosquitos, the collection, preservation and examination of specimens, the relation of mosquitos to malaria and western equine and St. Louis encephalitis, the species associated with various types of breeding place (flood-water, rain pools, snow water, tree-holes, irrigation water, permanent ponds, tidal water, log ponds and water in artificial containers), natural enemies, methods of making surveys, and measures for the control of larvae and adults. It is believed that *Anopheles maculipennis freeborni* Aitken is the only mosquito of any importance as a vector of malaria in the area, though three other Anophelines occur there, and that *Culex tarsalis* Coq. is undoubtedly the chief vector of the two encephalitis viruses [*cf. R.A.E.*, B **41** 127, etc.]. The second half is concerned with the individual species and includes brief descriptions of the adults and larvae, data on distribution, bionomics and economic importance, distribution maps, and keys to the adults, based on external characters and male genitalia, and to the larvae.

PAPERS NOTICED BY TITLE ONLY.

WIGGLESWORTH (V. B.). **The Principles of Insect Physiology.**—5th edn., revd., 10 × 6¼ ins., viii + 546 pp., 355 figs., many refs. London, Methuen & Co. Ltd.; New York, E. P. Dutton & Co. Inc., 1953. Price £2 2*s*. [*Cf. R.A.E.*, B **27** 169.]

HENRARD (C.). **Une tsé-tsé nouvelle du groupe** "*fusca*", *Glossina Vanhoofi*, **sp. nov.** [in Belgian Congo].—*Rev. Zool. Bot. afr.* **45** fasc. 3–4 pp. 193–197, 2 figs. Tervuren, 1952.

HORNSTEIN (I.). **Report on Benzene Hexachloride** [methods for determining γ isomer in technical BHC and BHC formulations].—*J. Ass. off. agric. Chem.* **36** no. 2 pp. 367–369, 7 refs. Washington, D.C., 1953. [*Cf. R.A.E.*, B **41** 48.]

GIANG (P. A.). **Report on Parathion** [methods of determination].—*J. Ass. off. agric. Chem.* **36** no. 2 pp. 384–387, 5 refs. Washington, D.C., 1953. [*Cf. R.A.E.*, B **41** 48.]

La Casse (W. J.) & Yamaguti (S.). **Mosquito Fauna of Japan and Korea.** —3rd edn., [2+] viii + 268 + 7 + 213 pp., 96 pls., 94 figs., 51 maps, 33 refs., multigraph. Kyoto, Honshu, Off. Surg., 8th U.S. Army [& Washington, D.C., Off. Surg. Gen. U.S. Army], 1950.

This is the third and enlarged edition of a work of which the previous editions had a more or less restricted circulation. The main part comprises descriptions of the adults, and larvae where known, of the mosquitos of Japan and Korea, with brief notes on their biology, and their relation to disease if evidence is available. Illustrations of the characters of the adults of all but one of the species and of the larvae and pupae of most of them are included. With very few exceptions, synonymy is not considered, but the Culicini include one new species described in the present edition from larvae, the adult being unknown, and another species and a variety that were first described in the second edition (1948). *Anopheles edwardsi* Yam. is considered a subspecies of *A. koreicus* Yam. & Watan. [*cf. R.A.E.*, B **38** 113]; both are recorded from Hokkaido, Honshu and Kyushu and *edwardsi* also from Korea, and larvae of both were sometimes present in the same breeding place. The characters supposed to differentiate the adults and larvae were found to intergrade.

There are two separately paged appendices. The characters of the female terminalia differentiating the subgenera are described in the first, and the second is essentially a compilation of data obtained in the field during the occupation of Japan by the U.S. army, when much attention was being devoted to the risks of mosquito-borne diseases and particularly Japanese B encephalitis. It is divided into sections concerned, respectively, with: the organisation and functions of malaria survey detachments; survey methods and technique (including the processing of mosquitos for virus isolation); temperature and precipitation during the six months when mosquitos are active at Kyoto, Honshu; the hibernating habits of mosquitos; the species of mosquitos occurring in Korea; the more important sources of mosquito breeding that were observed during routine surveys in Japan; mosquito control in Japan (principally by the use of DDT against adults and larvae); mosquito-borne diseases in Japan (malaria, dengue fever, filariasis caused by *Wuchereria bancrofti* and Japanese B encephalitis); studies on mosquito bionomics, temperature and rainfall and their probable relationship to Japanese B encephalitis from which it was concluded that no correlation can be found between outbreaks of the disease and rainfall or temperature; and finally studies on the biology of *Culex tritaeniorhynchus* Giles, one of the most abundant and widely distributed of the mosquitos found in Japan and probably an important vector of Japanese B encephalitis [*cf.* **40** 163].

Leleup (N.). **Un anophèle cavernicole nouveau du Kibali-Ituri:** *Anopheles Faini* **n. sp.**—*Rev. Zool. Bot. afr.* **46** fasc. 1–2 pp. 151–158, 4 figs., 1 ref. Tervuren, 1952.

Descriptions are given of the larva, pupa and adults of both sexes of *Anopheles faini* sp. n., which was taken in caves in Kibali-Ituri, Belgian Congo, in October 1951 and March 1952. In bionomics, it closely resembles *A. vanhoofi* Wanson & Lebied and *A. rodhaini* Leleup & Lips [*R.A.E.*, B **34** 39; **41** 30].

Sudia (W. D.). **The Effect of flowing Water on Mortality Rates of** *Aedes aegypti* **(L.) Larvae.**—*Ohio J. Sci.* **52** no. 2 pp. 76–79, 2 refs. Columbus, Ohio, 1952.

The effect of flowing water on the development of larvae of *Aëdes aegypti* (L.) was studied in the laboratory by leaving batches of 25 larvae for 4–72

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hours in tanks of water flowing at different rates while a control batch was exposed in still water in otherwise identical conditions. The larvae were five days old at the beginning of the test and were then kept until the adults emerged. The mortality percentages were estimated from the numbers of adults obtained. It was found that whereas the duration of exposure in the jar of still water did not affect mortality, which was always about 6 per cent., the percentages were invariably higher in flowing water and increased with the velocity and with the duration of exposure in it. It was calculated from the figures obtained that 50 per cent. mortality would result from exposure in water flowing at 0·5, 1, 2, 3 and 4 ft. per second for 60–70, 60–72, and less than 8, 4 and 4 hours, respectively.

Heisch (R. B.) & Guggisberg (C. A. W.). **Notes on the Identification of Kenya Sandflies.**—*E. Afr. med. J.* **29** no. 10 pp. 423–432, 12 pls., 5 refs. Nairobi, 1952.

A list is given of the 19 species of *Phlebotomus* (and two varieties of one of them) that have been identified from Kenya, with keys to the females and the males where known. Brief descriptions are also given of the distinguishing characters of both sexes of all and illustrations of these characters for all except one species. Errors in former identifications or changes in nomenclature revealed by study of Kirk & Lewis' work [*R.A.E.*, B **41** 17] are indicated.

Leclercq (M.). **Introduction à l'étude des Tabanides et revision des espèces de Belgique.**—*Mém. Inst. Sci. nat. Belg.* no. 123, 80 pp., 30 maps, 13½ pp. refs. Brussels, 1952.

This work is in two parts. The first comprises a review of the biology and economic importance of the Tabanids of the world and includes a table of the pathogenic agents transmitted by Tabanids, showing the geographical distribution of the vectors, and others of the flowers on which the various species feed, the parasites of all stages, and Asilid and Hymenopterous predators, showing in each case the species concerned and the author, date and country of origin of the record. The second part comprises a revision of the Belgian species, with keys to adults of both sexes, maps of Belgian distribution and a table relating Belgian distribution with occurrence in certain other European countries.

Camin (J. H.) & Rogoff (W. M.). **Mites affecting Domesticated Mammals.**—*Tech. Bull. S. Dak. agric. Exp. Sta.* no. 10, 12 pp., 3 figs., 1 fldg. chart, 11 refs. Brookings, S. Dak., 1952.

Notes are given on the identification, by means of the site affected and lesions caused, and on the control of mites of the genera *Demodex*, *Sarcoptes*, *Psoroptes*, *Chorioptes*, *Notoëdres*, *Otodectes* and *Trombicula* on domestic mammals (the hosts affected being given in most cases) and on *Pneumonyssus caninum* Chandler & Ruhe, which infests the nasal membrane and frontal sinuses of dogs and for which no practical control measure is known, and *Bdellonyssus bacoti* (Hirst), which may have to be controlled in laboratory animals. Mention is also made of *Cheyletus eruditus* (Schr.), which is predacious on other mites and *Cheyletiella parasitivorax* (Mégn.), which is probably predacious [*cf. R.A.E.*, B **38** 190; **39** 38]. A note on the collection and mounting of specimens and an illustrated key to the mites dealt with are appended.

Ryckman (R. E.), Ames (C. T.) & Lindt (C. C.). **A Comparison of Aldrin, Dieldrin, Heptachlor and DDT for Control of Plague Vectors on the California Ground Squirrel.**—*J. econ. Ent.* **46** no. 4 pp. 598–601, 2 refs. Menasha, Wis., 1953.

In preliminary field tests in 1951 in which eight chlorinated hydrocarbons were used to dust 5,600 burrows of California ground squirrels (*Citellus beecheyi*) for the control of the flea vectors of plague, the most effective were heptachlor, aldrin and dieldrin. They were used at concentrations of 3, 1·5 and 2 per cent., respectively, and reduced flea indices to 2, 2·22 and 3·91 per animal, whereas 5 per cent. DDT (the standard of comparison) resulted in an index of 90·85. These insecticides were therefore tested further during 1952. Dieldrin was used to compare four methods of treatment, surface dusting and spraying (at about 1 lb. actual insecticide per acre) and dusting or spraying of burrows (in the latter case with 0·64 gm. per burrow). Flea indices, which ranged from 39·7 to 70·1 before treatment, were reduced to 0·48 by spraying burrows, 1·15 by surface spraying, 2·51 by dusting burrows and 4·87 by surface dusting. Treating the surface of pasture land with dieldrin is not recommended because of its toxicity to mammals. To provide high, uniform and heavily infested ground-squirrel populations for comparison of the insecticides and to ensure rapid trapping and accuracy, experiments were made on populations enclosed by electric fences. Applications of 2·5 per cent. heptachlor, 2·5 per cent. aldrin, 2 per cent. dieldrin or 5 per cent. DDT at 30 gm. dust per burrow entrance were made with a dust gun to all burrows in a fenced field. After 3–4, 13–17 and 35 days, all except DDT had reduced flea indices, which had been very high, by more than 98 per cent. and usually by more than 99 per cent. At the same times DDT had given 58·35, 71·28 and 95·4 per cent. control. The fleas present were *E[chidnophaga] gallinacea* (Westw.), by far the most numerous, *H[oplopsyllus] anomalus* (Baker) and *D[iamanus] montanus* (Baker).

Lindquist (A. W.), Roth (A. R.), Hoffman (R. A.), Yates (W. W.) & Ritcher (P. O.). **Chemotherapeutic Use of Insecticides for Control of Bloodsucking Insects.**—*J. econ. Ent.* **46** no. 4 pp. 610–614, 1 ref. Menasha, Wis., 1953.

The chemotherapeutic use of chemicals for the control of blood-sucking Diptera was studied in Oregon in 1952 when several insecticides (in groundnut oil) were injected subcutaneously into mice and calves and the effect on flies and mosquitos was noted. White mice into which the insecticides had been injected at 25 mg. per kg. body weight were exposed to *Chrysops discalis* Will. and mosquitos, most of which were *Aëdes dorsalis* (Mg.). Selected typical results are given. Dieldrin and aldrin gave 100 per cent. kill of *Chrysops* feeding on the mice for several days (up to 16 and 13 days, respectively, in the case of individual mice). Nearly all the mice died, probably owing to the effects of the insecticides. Neither dieldrin nor aldrin gave more than about 50 per cent. kill of mosquitos in 36 trials over several days. Heptachlor gave 100 per cent. kill of *Chrysops* in several tests and was somewhat better than dieldrin or aldrin against mosquitos, but mice treated with it lived only 3–7 days. Lindane [γ BHC], which was injected at 50 and 75 as well as 25 mg. per kg., gave inconsistent and poor mortality of both *Chrysops* and mosquitos, but killed only four of 14 mice. Little toxicant was excreted through the skin to contaminate the hair. Little or no toxicity to *Chrysops* or mosquitos was shown by DDT, several DDT analogues, toxaphene, or a group of sulphones.

In the tests on calves, single animals were treated with dieldrin or heptachlor (at 25 mg. per kg.) or allethrin (at 100 mg.), two with aldrin (at 25 mg.), and eight with lindane (at 10–75 mg.). Three of the lindane-treated calves died, one three days after treatment at 10 mg. and the others 21 and 51 days after treatment with 50 or 75 mg. The calves treated with dieldrin and aldrin lost weight and appeared listless for 2–3 weeks. Lindane at rates of 50 or 75 mg. was the only treatment that showed any promise against either mosquitos or Tabanids. At these rates it was toxic to mosquitos for up to 21 days after injection. It was less effective against *Chrysops*, of which it gave 40–100 per cent. mortality for several days, and it was not very effective against some species of *Tabanus*. A large population of the horn-fly, *Siphona irritans* (L.), was eradicated in the course of a week from the five-acre pasture on which the experimental herd was kept, and the only animals on which dead horn-flies were found were those that had been treated with lindane.

Gustafson jr. (C.), Lies (T.) & Wagner-Jauregg (T.). **Action of some Aliphatic Thiocyanates against DDT-resistant Strains of the House Fly.**—*J. econ. Ent.* **46** no. 4 pp. 620–624, 13 refs. Menasha, Wis., 1953.

Comparative tests were made of the action of alkyl thiocyanates (RSCN), thiocyanohydrins (HORSCN) and different ester types (RCOOR′SCN and ROCOR′SCN) against DDT-resistant house-flies [*Musca domestica* L.]. Though these substances are not so effective as DDT against normal flies, they are approximately equally toxic for DDT-resistant and normal strains and superior to DDT against the former. The properties of the compounds used and the knockdown and kill of resistant flies that they effected when tested as contact insecticides by coating petri dishes are shown in tables. Ethyl and heptyl thiocyanate had relatively low toxicity and knockdown activity. They are stable but have an objectionable odour. Tetramethylene thiocyanohydrin, cyclohexene thiocyanohydrin and 2-thiocyano ethyl caproate were somewhat more active, and 4-chloro butyl thiocyanate came between this group and the next, which comprised 2-thiocyano ethyl propionate, 4-thiocyano butyl propionate, 3-thiocyano propyl butyrate and 3-thiocyano propyl propionate (the propionic and butyric acid esters of thiocyanohydrins of the formula $HO(CH_2)_n$ SCN (n = 2,3,4)). These combined the highest knockdown and killing capacities. An unsaturated homologue, 3-thiocyano propyl crotonate, could be included with them. The substances in this group are chemically stable and free from irritancy and objectionable odour when pure, and their toxicity to mice was relatively low. They are therefore the most likely to have practical value and should be tested as space sprays. Capryl β-thiocyano propionate and capryl thiocyano acetate, tested against later generations of the resistant strain, also showed high toxicity.

When injected intravenously in propylene glycol solution into mice, 2-thiocyano ethyl isovalerate had a median lethal dose of 15 mm.^{3} per kg. and 2-thiocyano ethyl propionate, 3-thiocyano propyl butyrate and 3-thiocyano propyl propionate each had one of 30 mm.^{3} per kg. while the toxicities of 4-thiocyano butyl propionate and 3-thiocyano propyl crotonate were between these figures. The median lethal doses of ethyl thiocyanate and tetramethylene thiocyanohydrin for rabbits were 5–6 and 6–7 mg. per kg. Experiments with tetramethylene thiocyanohydrin showed that it liberates cyanide ions when injected into rabbits, p-amino-propiophenone protected against it, and it produced a rise in blood pressure suggestive of a cyanide-like action in cats that were receiving artificial respiration.

Hayes (R. O.). **Determination of a physiological Saline Solution for *Aedes aegypti* (L.).**—*J. econ. Ent.* **46** no. 4 pp. 624–627, 14 refs. Menasha, Wis., 1953.

Physiological saline solutions used for several insects are reviewed, and the methods employed to determine a satisfactory one for *Aëdes aegypti* (L.) are given. The use of such a medium would be readily applicable in surveys involving the dissection of mosquitos to determine their potential importance as vectors of disease, in morphological and physiological studies and in studies on parasites using the mosquito as their developmental host. A modified Belar's saline solution consisting of 9 gm. sodium chloride, 0·2 gm. calcium chloride, 0·2 gm. potassium chloride and 0·1 gm. sodium bicarbonate per litre of distilled water was found to be the most satisfactory saline tested.

Fulton (R. A.), Sullivan (W. N.) & Mangan (G. F.). **Effectiveness of Lindane Vaporizers.**—*J. econ. Ent.* **46** no. 4 pp. 639–641, 1 fig., 3 refs. Menasha, Wis., 1953.

An account is given of experiments on the functioning of an electrically-heated device for dispersing vapour of γ BHC as lindane in enclosed spaces [*cf. R.A.E.*, B **40** 176] and the concentrations of vapour likely to be present in a treated space. The vapour concentrations are given in mmg. per litre; multiplication by 28·3 converts them to mg. per 1,000 cu. ft. The tests were made in a room with a capacity of about 11,000 cu. ft. and having three large windows and two doors. Lindane was vaporised at about 1 gm. per day from a Pyrex cup fixed to an outside wall about 6 ft. from the floor and 5 ft. from the ceiling; the temperature of the air between the heating element and the cup was 118°C. Concentrations of lindane vapour per litre of air in different parts of the room varied from 0·11 to 0·18 mmg. when there was no ventilation and from 0·042 to 0·049 mmg. when all the windows and one door were open, but when one window and one door were open, there was a wide variation (0·05 to 0·3 mmg.) caused by air eddies. When the air was circulated through an air-conditioning unit, the amount of lindane in the water removed (about 2 U.S. gals. per day) had little effect on the concentration remaining.

In a test on the effect of the vapour on house-flies [*Musca domestica* L.] the amounts, in gm., of lindane vaporised in 24 hours, the lindane concentrations in mmg. per litre and the percentage mortalities in 24 hours with an exposure period of three hours were 1·7, 0·067 and 97 when doors and windows were closed, 1·7, 0·016 and 62 when they were open, and 0·91, 0·17 and 100 when they were closed but the air-conditioning unit was in operation. In the last case, mortality was also complete with an exposure period of one hour. In tests with other insects, the mortality percentages after exposure to a concentration of 0·17 mmg. per litre for one, seven and 11 days, respectively, were 6, 38 and 63 in the American cockroach [*Periplaneta americana* (L.)], 0, 42 and 96 in the oriental cockroach [*Blatta orientalis* L.], 0, 70 and 91 in the German cockroach [*Blattella germanica* (L.)], 90, 100 and 100 in the brown-banded cockroach [*Supella supellectilium* (Serv.)], 0, 0 and 10 in the confused flour beetle [*Tribolium confusum* Duv.] and 0, 0 and 0 in carpet-beetle larvae [? *Anthrenus scrophulariae* (L.)]. After exposure for three days to a concentration of 0·33 mmg. built up by four vaporisers, the mortality percentages were 69 in *Periplaneta*, 99 in *Blatta*, 100 in *Supella*, 98 in *Tribolium* and 4 in the carpet-beetle larvae.

Bushland (R. C.) & Hopkins (D. E.). **Sterilization of Screw-worm Flies with X-rays and Gamma-rays.**—*J. econ. Ent.* **46** no. 4 pp. 648–656, 16 refs. Menasha, Wis., 1953.

Preliminary tests on the possibility of sterilising large numbers of the screw-worm fly, *Callitroga hominivorax* (Coq.), for release among isolated natural populations showed that sterilisation could be effected by X-rays administered to pupae during their last two days of development [*R.A.E.*, B **40** 43]. However, the use of X-rays would be too costly for large-scale releases. Tests were therefore made in Texas in 1952 to compare the effectiveness of γ-rays from a radio-active cobalt source, which could be obtained more cheaply. The age at which pupae were most readily sterilised and the stage of pupal development at which the adverse effects of the radiations were best tolerated were also examined.

The literature on the genetic effect of X-rays and γ-rays on various insects is reviewed. It is believed that the effects of ionising radiations on protoplasm are to induce physical and chemical changes in the molecules. These changes may so alter the complex organic molecules of genes and chromosomes as to cause aberrations in their structure and composition and thereby affect their function. A change in genetic constitution of a sperm may not prevent fertilisation, but the zygote may be unable to develop beyond the embryonic stage. Such a phenomenon is called a dominant lethal effect, and it is believed that the sterility of irradiated screw-worm flies is an expression of this effect.

The technique used in rearing the flies and the irradiation equipment are described. The γ-ray equipment had an accuracy of ± 10 per cent. Comparisons of three cultures of pupae treated when six days old with 5,000 r (roentgens) of X-rays or γ-rays indicated that the effects of the two kinds of radiation were similar in that neither treatment killed pupae of either sex or affected the length of life of adult females, but adult males from irradiated pupae did not live so long as normal males. Subsequent work was carried out with γ-rays only. Seven cultures were treated as pupae six days old with 5,000 r, and the adults caged with normal adults of the opposite sex. Normal males and females were also kept together for comparison. Within 10–13 days of emergence, 56·4 per cent. of treated males and 62·6 per cent. of treated females had died, whereas the percentage deaths of untreated males and females caged with them were 40·7 and 47·9, respectively. The difference appeared significant in the case of the males but not in that of the females. Very few of the treated females oviposited, and the egg-masses laid by those that did so contained less than half the usual number of eggs. Some of these eggs showed partial development, but only two larvae hatched so that, for practical purposes, all the females were sterile. Normal females caged with irradiated males oviposited normally but no eggs hatched. In a further test in which groups of pupae were irradiated when six days old at dosages varying from 5,000 to 20,000 r, fewer control flies than treated ones died within seven days, but there was no apparent difference in mortality between the various treated groups. After 13 days, as many flies had died in the untreated as in the irradiated group.

When dosages of 2,500, 3,000, 3,500 and 4,000 r were administered to pupae 3, 4, 5, 6 and 7 days old, the highest dosage reduced adult emergence from the pupae treated when 3 and 4 days old but not from the others. A dosage of 3,000 r had no effect on emergence. The lowest two dosages had no apparent effect on length of adult life, whatever the age of the pupae when treated. The higher ones appeared to be especially harmful to the youngest pupae, but the data were erratic. All the treatments produced almost but not quite complete sterility in males. The lowest

dosage had practically no effect on the fertility of females except when very young pupae were treated. The higher dosages were increasingly more effective but none caused very high sterility in the oldest pupae. In both sexes, pupae 6 and 7 days old were harder to sterilise than younger ones. The results suggested that no dose below 5,000 r can be depended on to produce total sterility, and that it is best to treat the pupae after they have completed five days of development. When males sterilised by γ-rays were caged with normal flies of both sexes, the irradiated males competed for mates about equally with the normal males.

Smith (C. N.) & Gilbert (I. H.). **Effectiveness against Mosquitoes of general-purpose Repellent Mixtures for Application to Clothing.**—*J. econ. Ent.* **46** no. 4 pp. 671–674, 1 ref. Menasha, Wis., 1953.

In 1951 and 1952, 15 modifications of the standard clothing repellent mixture M-1960 (containing equal parts of benzyl benzoate, N-butylacetanilide and 2-butyl-2-ethyl-1,3-propanediol and 10 per cent. Tween 80 [*cf. R.A.E.*, B **40** 62; **41** 203] were tested on stockings against *Anopheles quadrimaculatus* Say and *Aëdes aegypti* (L.) in the laboratory and against salt-marsh mosquitos (principally *A. taeniorhynchus* (Wied.)) in the field. In 11 of the modified formulae, one or other of the first three ingredients was replaced by another compound; two of the remainder comprised mixtures of other compounds only, and the other two were mixtures of the standard with other compounds. All mixtures contained 10 per cent. Tween 80.

Seven of the mixtures contained undecylenic (hendecenoic) acid and all these were more effective than the standard against *A. aegypti*. No mixture was effective for a longer time than the standard against *Anopheles quadrimaculatus*. Three mixtures containing N-butyl-4-cyclohexene-1,2-dicarboximide and either 2-butyl-2-ethyl-1,3-propanediol or undecylenic acid were superior to the standard in the length of time for which they gave protection from the first or fifth bite or both by salt-marsh mosquitos. Some mixtures in which another compound had been substituted for 2-butyl-2-ethyl-1,3-propanediol were less effective than the standard against these mosquitos. Replacement of N-butylacetanilide by N-propylacetanilide or N-isopropylacetanilide caused no consistent changes in effectiveness.

Tashiro (H.) & Schwardt (H. H.). **Some natural Enemies of Horse Flies in New York.**—*J. econ. Ent.* **46** no. 4 pp. 680–681, 2 figs., 1 ref. Menasha, Wis., 1953.

Parasites of the eggs of Tabanids found in New York in the summer of 1949 comprised *Trichogramma semblidis* (Auriv.), which had parasitised 57 of 73 egg-masses of *Chrysops* sp. collected on leaves of *Typha* bordering a pond and destroyed most of the eggs in them, and the Scelionids, *Telenomus goniopis* Crwf. and *T. tabanivorus* (Ashm.), which were obtained from egg-masses of *Tabanus lasiophthalmus* Macq. and *T. atratus* F., respectively. Eggs from which any of the parasites had emerged could be distinguished by the circular emergence hole from those that had hatched normally, as these had a longitudinal slit. One *Tabanus* larva, probably *T. reinwardtii* Wied., was found to contain a puparium from which a male of *Vibrissotheresia pechumani* Reinhard was reared. This Tachinid was previously known only from the holotype male, which was collected in New York and described in 1943.

Tashiro (H.) & Schwardt (H. H.). **Notes on the Biology of** *Tabanus giganteus*.—*J. econ. Ent.* **46** no. 4 pp. 681–682, 1 fig., 1 ref. Menasha, Wis., 1953.

Limited observations on the bionomics of *Tabanus giganteus* Deg. were made in central New York in 1948–50. The adults, of which 13 were collected and others observed, were present in August and early September. They attacked the backs of cattle, readily entered vehicles or buildings and often alighted and rested on the warm bonnet of a car on cool, damp mornings. A female collected in 1948 laid an egg-mass on 10th September and larvae hatched from it after 10–11 days. They were kept in glasses containing damp sand and fed on segments of earthworms, but also attacked one another. All those that survived hibernated twice, and 17 gave rise to adults in July–September 1950 after a pupal stage of 16–24 days. The 16 larvae that remained in mid-September were killed, so that it is not known whether they would have hibernated a third time. Characters are given for separating the larva from that of *T. sulcifrons* Macq., and the appearance of the egg-mass and colour of the eggs, which are believed to be peculiar to the species, are described.

Stoner (R. D.) & Hale (W. M.). **A Method for Eradication of the Mite,** *Myocoptes musculinus*, **from Laboratory Mice.**— *J. econ. Ent.* **46** no. 4 pp. 692–693, 6 refs. Menasha, Wis., 1953.

Laboratory mice were freed from infestations by the Listrophorid mite, *Myocoptes musculinus* (Koch), by submerging them three times at intervals of five days in a dip containing 0·2 per cent. technical DMC (di(p-chlorophenyl)methylcarbinol) and scrubbing them about the eyes, ears and mouth with a cotton pad saturated with the liquid. The dip was prepared by dissolving the DMC in 95 per cent. ethyl alcohol and diluting to 50 per cent. with water. A few mites survived when the concentration of DMC in the dip was halved, and some of the mice were killed when it was doubled. As supplementary measures, mice to be treated should be isolated in a separate room; colony breeding rooms and experimental rooms should be made proof against wild mice; ceilings, walls, floor and shelves should be painted with the 0·2 per cent. DMC, and apparatus should be autoclaved. With these precautions, a colony was maintained free of mites for nine months.

Davis (J. M.) & Elliott (K. R.). **A rapid Method for estimating Aerial Spray Deposits.**—*J. econ. Ent.* **46** no. 4 pp. 696–698, 2 figs., 1 ref. Menasha, Wis., 1953.

The authors describe the preparation and use of dyed paper to indicate the degree of atomisation of the droplets and the deposit from oil-based sprays applied from aeroplanes. An oil-soluble red dye is dissolved in acetone, applied to glazed white paper by brushing or immersion and allowed to dry, and the treated paper is sensitive to almost any oil-base solution. When a spray droplet strikes the paper, it appears to dissolve the dye and carry most of it to its perimeter; this results in a circular pinkish spot outlined by a dark ring of dye. Over a considerable range of droplet sizes, the ratio of the diameter of the ring to that of the droplet producing it is fairly constant, ranging from 6 : 1 to 7 : 1 according to the characteristics of the spray used. Because this ratio is large, small droplets are readily visible, and because of its constancy, the method can be used for the rough determination of droplet sizes. The deposits can be evaluated

visually to an accuracy of about 5 per cent. by comparing them with previously prepared papers bearing known deposits. The papers can be left exposed in the field for several days, are not affected by rain or dew and may be retained as a permanent record. In addition to indicating adequacy of coverage, they can be used in determining the relation between dosage and mortality.

The chief advantages of the method are the ease of handling and the rapidity of evaluation. It has proved useful in studying the deposits obtained in forest spraying in Canada and the United States and may be adapted for use in accurate experimental spraying.

MITLIN (N.) & GERSDORFF (W. A.). **The Stabilization of Scabrin Oil Sprays.** —*J. econ. Ent.* **46** no. 4 pp. 698–699, 5 refs. Menasha, Wis., 1953.

As spray solutions of scabrin in kerosene lost toxicity to *Musca domestica* L. if allowed to stand [*R.A.E.*, B **40** 175], five antioxidants were tested as stabilisers. The solutions contained 2 mg. scabrin per ml. refined kerosene, and the antioxidants other than hydroquinone were used at 1 mg. per ml. Hydroquinone, which is less soluble, was used at saturation. The solutions were tested as sprays against *M. domestica* by the turntable method [**26** 246] when fresh and after storage for periods of up to 79 weeks.

The antioxidants alone in refined kerosene were relatively non-toxic, but four of them, mono-tert.-butyl-m-cresol, 2,2′-methylene-bis-(4-methyl-6-tert.-butylphenol), Phenol S (a mixture of isopropyl cresols) and hydroquinone effectively stabilised the scabrin for 79 weeks. The fifth, di-tert.-butyl-p-cresol, allowed deterioration to set in after 11 weeks.

WILSON (H. G.), GAHAN (J. B.) & MCDUFFIE (W. C.). **Toxicity of Vapors of four Chlorinated Hydrocarbon Insecticides to resistant House Flies.** —*J. econ. Ent.* **46** no. 4 pp. 699–700, 1 ref. Menasha, Wis., 1953.

The following is the authors' summary. Laboratory studies in 1952 with non-resistant house-flies (*Musca domestica* L.), flies resistant to DDT only, and flies resistant to several chlorinated hydrocarbon insecticides showed that their resistance to vapours of lindane [γ BHC], chlordane, dieldrin, and aldrin was closely correlated with their resistance to residues of lindane, less closely with resistance to residues of DDT. The exposure times required to cause mortality were too long to justify the conclusion that these materials could be used as vapours to control resistant flies.

PRATT jr. (J. J.) & BABERS (F. H.). **Sensitivity to DDT of Nerve Ganglia of susceptible and resistant House Flies.**—*J. econ. Ent.* **46** no. 4 pp. 700–702, 4 refs. Menasha, Wis., 1953.

The view that the greater ability of resistant house-flies (*Musca domestica* L.) to metabolise DDT to DDE [1,1-bis(p-chlorophenyl)-2,2-dichloroethylene] is not the cause of their resistance [*R.A.E.*, B **41** 123] is supported by the fact that tissues of resistant flies showing no symptoms of poisoning may contain amounts of DDT many times greater than those that would be lethal to susceptible flies. It is probable that some other mechanism inhibits the poisoning of resistant flies by DDT, and that differences in ability to metabolise DDT may be associated with the degree to which the fly is poisoned. The comparative susceptibility to DDT-poisoning of nerve tissue of flies of a susceptible and a resistant strain was investigated in two series of experiments in which DDT was applied to the fused

thoracic ganglion, which had been exposed without injuring the nerve to one of the legs. Tremors in the leg were used as the criterion of poisoning. In the first series, in which 0·57 μg. DDT was applied to the ganglion of 25 susceptible and 25 resistant flies, 22 susceptible and 16 resistant flies were showing leg tremors after five minutes and 19 and 4 were still doing so after 60 minutes. In the second series in which 1·14 μg. DDT was applied to 15 flies of each strain, all the susceptible flies and nine resistant ones were showing leg tremors after five minutes and 14 and four were still doing so after 120 minutes. The results suggest that in resistant flies, the ganglionic tissue is less susceptible to DDT poisoning than in susceptible flies and recovery from the poisoning is more rapid. It is difficult to correlate the theory that detoxification of DDT by metabolism to DDE is the cause of resistance with the first observation, since it is unlikely that the DDT would be metabolised rapidly enough to prevent the appearance of symptoms after direct application to the ganglion. In no case in which tremors had begun, did they cease within five minutes of treatment. This would also preclude the possibility that DDE might serve to block the action of DDT. The more rapid recovery of the resistant flies is probably due to detoxification of the DDT, but does not necessarily indicate a faster rate of detoxification in resistant flies. The dosage threshold for poisoning is probably higher in them and had not been reached in flies that showed no symptoms in five minutes.

Dicke (R. J.). **Maggot Therapy of Actinomycosis.**—*J. econ. Ent.* **46** no. 4 pp. 706–707, 1 ref. Menasha, Wis., 1953.

An advanced case of mandibular actinomycosis in a Guernsey bull in Wisconsin was successfully arrested by the application of several thousand larvae of *Lucilia* (*Phaenicia*) *sericata* (Mg.) to the diseased area fortnightly from October till May. In summer, spontaneous infestation by *L. sericata* and *Phormia regina* (Mg.) occurred. When the first application was made, the disease had been in progress for at least two years, the tumour-like lesion had broken through the jaw-bone and skin, deep suppurating sinuses perforated the osseous structure, and the parotid region was involved. The bull was very weak and emaciated, respired with difficulty and could not feed. Within a few days, the condition of the peripheral area had considerably improved and the animal was able to masticate and swallow food. Three months later, feeding and respiration were normal, and the animal had gained weight and resumed normal breeding activity. It continued in use as a herd sire for a year before its condition again deteriorated, possibly owing to an actinomycotic involvement of the lungs, and it was slaughtered.

Quarterman (K. D.) & Sullivan (W. N.). **Disinsectization of Aircraft by Lindane Vapors from Filters in the ventilating System.**—*J. econ. Ent.* **46** no. 4 pp. 715–716, 8 refs. Menasha, Wis., 1953.

Though other insecticides are generally used for treating aircraft to prevent dissemination of insect vectors of disease [*R.A.E.*, B **38** 187; **39** 186], γ BHC as lindane has shown considerable promise for use in aircraft either as a deposit or as a vapour [**40** 177]. An account is given of preliminary tests made in Georgia in October 1952 on free-flying female house-flies [*Musca domestica* L.] in a Constellation aircraft in flight to determine whether lindane vapours dispensed from impregnated glass-wool metal-framed filters installed in the ventilation system [**40** 177] of large aircraft would be a practical method of controlling insects under pressurised

and non-pressurised conditions. Three filters impregnated with a total of 240 gm. lindane were used, and the average air velocity through them during the tests was about 450 ft. per minute. In one series of five tests made when the average lindane concentration was 0·16 μg. per litre of air, exposure of flies for 60 minutes resulted in an average mortality of 99 per cent. in 24 hours, and in another series of four with an average concentration of 0·09 μg. and exposure for 30 minutes, average mortality was 98 per cent. Pressurisation did not affect mortality.

During an hour's control flight before the filters were installed, the apparent lindane concentration in the aircraft was 0·03 μg. per litre air and mortality of the test flies was 5 per cent. After the nine flights of the two series of tests, the filters were removed and the aircraft was flown for an hour without them. The estimated lindane concentration was 0·02 μg., but mortality of the test flies was 97 per cent., indicating that a film of lindane had been deposited from the vapour during the preceding flights. When the aeroplane landed, more flies were exposed to the deposit by caging them on the walls for an hour. The mortality averaged 70 per cent., ranging from 10 to 100 per cent. according to the kind of surface on which the flies were caged and its position in the aeroplane.

Scott (M. T.). **Observations on the Bionomics of the Sheep Body Louse (*Damalinia ovis*).**—*Aust. J. agric. Res.* **3** no. 1 pp. 60–67, 1 graph, 4 refs. Melbourne, 1952.

An account is given of observations in New South Wales on the bionomics of *Damalinia ovis* (Schrank) *in vitro* and on artificially and naturally infested sheep, brief summaries of some of the results of which have already been noticed [*R.A.E.*, B **35** 71; **36** 118; **39** 30]. It does not now appear, however, that a relative humidity of 90 per cent. is less favourable for development than one of 50 per cent. [*cf.* **35** 71], since no nymphs reached the second instar at 35 or 39·5°C. [95 or 103·1°F.] if the humidity was 50 per cent., whereas very small numbers developed to adults at 35°C. and moderate numbers at 39·5° if the humidity was 90 or 70 per cent. The eggs hatched and the nymphs developed well at all three humidities if the temperature was 36·5°C. [97·7°F.]. Rearing was possible only at temperatures between 35 and 39·5°C., regardless of humidity, and oviposition ceased at the higher temperature. The temperature along the midline of the back of the sheep, where lice are most numerous [**35** 71], was found to be within this range throughout the year, varying from 36·1 to 38·6°C. [about 97–101·5°F.] on sheep kept under cover. The sexes were present on sheep in approximately equal numbers, in marked contrast to those of *D. bovis* (L.) on cattle [**38** 59]. Infestation is passed on principally by direct contact and lambs readily become infested from their mothers or other sheep, but individual sheep varied considerably in their susceptibility to both artificial and natural infestation. There was a tendency for the lice to be most numerous and to remain abundant throughout the year on sheep in poor condition. In an experiment in which cross-bred sheep were artificially infested in late winter with 10,000 lice per animal, and were then given a poor or a nourishing diet, infestation declined on all the animals during the summer, but increased rapidly during the next six months on the poorly fed sheep while dying out completely on the well fed ones [*cf.* **39** 30]. In a similar experiment with Merino sheep having light natural infestations, however, lice increased rapidly on both well and poorly nourished animals. There is a pronounced seasonal fluctuation in infestation, which is heaviest during June–September and lightest during December–March. A marked decline occurs when the sheep are

shorn, owing to the removal of some of the lice and their eggs and to the unfavourable temperature conditions to which those that remain are exposed.

KAMM (L.). **Neue Untersuchungen zur Dasselbekämpfung.** [New Investigations on Warble-fly Control.]—*Anz. Schädlingsk.* **25** pt. 6 pp. 81–84, 4 refs. Berlin, 1952.

Methods of controlling *Hypoderma* by summer treatment of cattle in mountain pastures in Germany [*cf. R.A.E.*, B **41** 23] were investigated in 1949–50, proprietary BHC preparations of unspecified content being used. In experiments on the destruction of the larvae, the liquids were rubbed by hand into the affected parts of the back, the scabs being removed from the orifices of the warbles. The treatment was very effective against larvae in the second instar but not against those in the third, and was still unsatisfactory against the latter when repeated ten days later. When the liquids were injected into the warbles, mortality of even third-instar larvae reached 89·5–97·2 per cent.

In tests of preventive treatments, one group of animals was sprayed 11 times at weekly intervals during the summer of 1949 with BHC at various concentrations in emulsified solution, a second was freed from larvae by the usual method three times during the summer, a third received both these treatments, and a fourth was left untreated. Counts of the warbles present in June–September 1950 showed that infestation was about the same as in the previous year for untreated animals, whereas it was reduced by 82·6 per cent. in the second group (indicating that the destruction of the larvae has some effect on subsequent infestation), and was prevented entirely by suitable concentrations of BHC in the first and third. Treatment of individual larvae is thus unnecessary, but is recommended until preventive measures are further developed.

STÜBNER (K.). **Fluoreszenzmikroskopischer Nachweis von DDT und seinen Mitteln.** [Fluorescent microscopic Detection of DDT and Preparations containing it.]—*Anz. Schädlingsk.* **25** pt. 7 pp. 97–100, 7 figs., 3 refs. Berlin, 1952.

The author figures and explains the use of an apparatus for projecting long-wave ultra-violet light or short-wave blue light on to the reflector of a microscope. DDT particles are fluorescent in this light and, when viewed microscopically through suitable filters, are clearly distinguishable from inert spray residues or dust carriers. The fluorescent effect can be used for the qualitative and to some extent the quantitative determination of DDT, for measuring the particle size and distribution of DDT in commercial insecticides, and for demonstrating its presence on plant surfaces and on or possibly in insects. When it was used to study the relation between DDT and inert carriers, it appeared from observations on the intensity of the fluorescence that the insecticide adheres to the surface of particles of slate dust but is absorbed by particles of kaolin and talc.

KLËSOV (M. D.). **Contribution to the Question of the Biology of two Nematodes of the Genus *Thelazia* Bosc, 1819, Parasites of the Eyes of Cattle.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **75** no. 4 pp. 591–594, 1 fig., 3 refs. Moscow, 1950.

Musca larvipara Porch. is the more important of the two flies that have been shown to be intermediate hosts of *Thelazia rhodesi* in the Ukraine

[*R.A.E.*, B **39** 205], and accounts are given of further investigations in 1949 on its relation to this nematode and to *T. gulosa*, which also infests the eyes of cattle in the Ukraine but is much less common than *T. rhodesi*. Over 5,000 females of *M. larvipara* were taken between April and October in a pasture containing a small herd of cattle infested by *T. rhodesi* and dissected, and the nematode was found in 3·5 per cent. of them. It was not found in 47 males collected with them, but males would be unlikely to acquire it, as only the females, which need food of animal origin for the normal development and functioning of the ovaries, visit the eyes of cattle. It was further found that the first-stage larvae of *T. rhodesi* enter the gut of the fly with the exudate from the eyes of cattle, pass into the abdominal cavity a few hours later and then reach the egg follicles, which cease to develop and in which they reach the infective stage [*cf.* **40** 70]. Total development in the fly lasts 15–30 days.

A healthy calf kept from 29th July to 1st September in a fly-proof cage into which large numbers of *M. larvipara* taken on the infested cattle were introduced at intervals became infested five times, 12 young nematodes (7 females, 4 males and 1 larva) being removed in all from the conjunctival cavities, whereas a control calf also kept in a fly-proof cage remained free from infestation. When 89 larvae of *T. rhodesi* in the infective stage were removed from the proboscis of *M. larvipara* and introduced into the conjunctival cavities of ten healthy calves kept isolated from flies, 67 sexually mature examples of *T. rhodesi* (25 males and 42 females) were recovered 20–25 days later.

Two larvae of *T. gulosa* were obtained in June 1948 from females of *M. larvipara* taken close to the eyes of infested cattle, and similar larvae were again obtained from the fly in June and July 1949 and one from the conjunctival cavity of a calf. Infective larvae of *T. gulosa* can be distinguished from those of *T. rhodesi* by various characters, including their size, being only half as long as the latter. When two infective larvae of *T. gulosa* from the proboscis of the fly were introduced in September 1949 into the conjunctival cavity of a healthy calf, a young female of *T. gulosa* (the measurements of which are given) was recovered a week later.

Pavlovskiĭ (E. N.). **The Reactions of the Tick** *Ornithodorus papillipes* **Bir. to certain physical Factors of the Environment.** [*In Russian.*] —*Parasit. Sborn.* **12** pp. 3–12, 16 figs. Moscow, 1950.

Experiments were carried out to study reactions of adults of *Ornithodoros tholozani* (Lab. & Mégn.) (*papillipes* (Bir.)) to light or dark sites, narrow spaces, and white or black backgrounds. The ticks were placed in horizontal glass tubes, 1·5 cm. in diameter and 30–40 cm. long, over the ends of which test-tubes having flat or rounded bottoms were slipped to different distances so as to provide narrow spaces between the ends of the tubes. Darkness was obtained by sliding paper cylinders over part or the whole of a tube, and pieces of black or white paper, some of them creased, were inserted to provide backgrounds. The experiments were carried out in diffused light at 16–19°C. [60·8–66·2°F.].

The following is based on the author's summary. The ticks normally congregated at the closed ends of the tubes. When black or white paper was inserted into the ends, they preferred the black. They preferred the darkened to the light end of a tube, and when half was covered with a cylinder of black paper and the other half with one of white, they showed no preference for two days and then congregated in the darker end. A black paper cylinder in the middle of the tube induced the ticks to leave

the ends in less than an hour and congregate in the dark central section. If this was made slightly less dark, the ticks wandered and only occasionally congregated in the shaded part. In diffused light, they settled between the folds of creased white paper placed at one end of the tube, even when the other end was dark but without folded paper. Complete darkness induced the ticks to settle among the folds more quickly. When folded paper was placed in the middle of the tube in light, the ticks congregated there in the course of 3–4 days if the paper was white and in a few hours if it was black. Comparatively wide spaces between flat pieces of glass in the middle of the tube were not very attractive. It is concluded that the distribution of the ticks depended on the degree of the shading and the shape of the space available.

Monchadskiĭ (A. S.). **Mosquito Attack on Man under the natural Conditions of the Subarctic and Factors regulating it.** [*In Russian.*]—*Parasit. Sborn.* **12** pp. 123–166, 6 graphs, 52 refs. Moscow, 1950.

Blood-sucking Diptera are very troublesome in the Arctic zone of the Soviet Union, and a study of the species concerned and the factors that affect their activity was carried out in June–August in 1946 and 1947 at a latitude of 67°30′N. on the high left bank of the Pechora, in an environment of tundra covered with shrubs. Collections were made mainly by means of a bell-shaped cover that was lowered over the author after he had sat in the open for five minutes at various times of the day and night [*cf. R.A.E.*, B **32** 214]. Mosquitos were far the most numerous and aggressive of the Diptera thus collected. Simuliids were much less active, and Ceratopogonids and Tabanids were scarce. The mosquitos taken under the cover comprised five species of *Aëdes*, of which *A. punctor* (Kirby) and *A. communis* (Deg.) predominated. Their numbers reached a peak in mid-July and began to decrease after about a fortnight, the decrease becoming progressively more rapid as the season advanced and the weather became less favourable.

The effects of meteorological conditions on the behaviour of the mosquitos are discussed at length. Temperature was the main factor affecting attack, which took place between 3·5 and 29°C. [38·3–84·2°F.] and was most intense between 9 and 24°C. [48·2–75·2°F.]. Light and wind were also important, bright light with an intensity of over 40 thousand lux having a marked depressing effect on activity, whereas a decrease in intensity below 1,500 lux had a stimulating effect, especially if the decrease was rapid. A wind of over 3·4 miles per hour was unfavourable, and attacks practically ceased when it reached 6·7 miles per hour. Differences in relative humidity between 35 and 100 per cent., changes in atmospheric pressure, and moderate rain had no effect on the mosquitos, but dew condensing on their body surfaces and heavy rain or prolonged drizzle with mist, sharply reduced activity.

In favourable weather, attacks continued without ceasing by day or night. On warm days in July, when the sun did not set, the peaks were in the morning and evening and the minimum at night. In cold weather, the peak occurred during the day, and there was no attack at night. In August, when the nights became dark, attack was intense from the evening until midnight when there was no dew and at a minimum during the day, particularly when the temperature was high and the light bright. With the onset of cold weather, attacks occurred only by day.

Radzivilovskaya (Z. A.). **Contribution to the Ecology of Larvae and Pupae of the Midges (Simuliidae) of the Mountain Regions of the South-Ussuri Taiga.** [*In Russian.*]—*Parasit. Sborn.* **12** pp. 199–224, 4 figs., 34 refs. Moscow, 1950.

Details are given of observations in 1939 and 1940; a brief account of the principal findings has already been noticed [*R.A.E.*, B **34** 110]. Simuliids of 17 species are recorded, with data on the temperature and the rapidity of the current of the parts of the streams in which their larvae and pupae were found, and on the vertical distribution of the larvae under various light conditions in July–August.

Nikol'skaya (M. N.). **A new Species of Parasite of Ixodid Ticks** *Ixodiphagus hirtus* **Nik., sp. n. (Hymenoptera, Chalcidoidea).** [*In Russian.*]—*Parasit. Sborn.* **12** pp. 272–274, 14 figs., 7 refs. Moscow, 1950.

Descriptions are given of the adults of both sexes of *Ixodiphagus hirtus*, sp.n., reared from nymphs of *Ixodes persulcatus* Schulze in the Maritime Province of the Soviet Far East in 1941, with a key to the three known Chalcidoid parasites of Ixodid ticks, the other two being *Hunterellus hookeri* How. and *Ixodiphagus texanus* How. [*cf. R.A.E.*, B **22** 144].

Shustrov (A. K.). **The Reaction of the Ticks** *Ornithodorus lahorensis* **Neum. and** *Argas persicus* **F.-W. to certain Factors of the Environment.** [*In Russian.*]—*Ent. Obozr.* **31** no. 3–4 pp. 393–397, 6 refs. Moscow, 1951.

An account is given of experiments by a technique already noticed [*R.A.E.*, B **42** 45], in which unfed adults of *Ornithodoros lahorensis* Neum. and *Argas persicus* (Oken) were placed in glass tubes, in some of which strips of paper provided crevices, and exposed to different conditions of light and darkness. The following is almost entirely the author's summary. In diffused light, semi-darkness or complete darkness, most of the ticks entered the crevices provided by the paper. When no crevices were available and part of the tube was darkened, they chose the darkened end. When crevices were provided at the illuminated end only, they entered them, and when they were provided at both ends, they entered those at the dark end. In the absence of all crevices, the ticks showed some preference for a light intensity of 15–40 lux over one of 2–8 lux, but preferred 3–20 lux to 250–360 lux. The results were the same for the two species of ticks and in summer and winter under identical laboratory conditions.

Alfeev (N. I.). **On the Changeability of Metamorphosis in Ixodid Ticks.** [*In Russian.*]—*Ent. Obozr.* **31** no. 3–4 pp. 398–403, 15 refs. Moscow, 1951.

Although Ixodids are usually classified as one-, two- and three-host ticks, some species have been shown to undergo more than one of these types of development [*cf. R.A.E.*, B **35** 140, etc.]. *Hyalomma dromedarii* Koch is such a species, and in experiments in 1944–46, its development when confined on one host (rabbit) was compared with that of *Boophilus calcaratus* (Bir.), a typical one-host tick. The only stages of *B. calcaratus* that moved to new positions on the animal after moulting were the adult males, which

migrated in search of females. In *H. dromedarii*, newly moulted nymphs and adults of both sexes moved to fresh positions, and an interval of a day or two seemed obligatory before they re-attached themselves. Similar, though shorter, periods of movement after moulting on rabbit also occurred in *H. scupense* Schulze, which is usually regarded as a one-host tick [*cf.* **40** 11]. These different modes of development are considered to represent stages in the evolution of ticks from three-host to one-host species, which is associated with increased rapidity of development.

Fedorov (V. G.). **Some Data on the Fauna and Phenology of the Mosquitos (Diptera, Culicidae) of the Environs of the Town of Chkalov.** [*In Russian.*]—*Ent. Obozr.* **31** no. 3–4 pp. 587–594, 4 refs. Moscow, 1951.

A list is given of 18 species of mosquitos taken in the environs of the town of Chkalov, near the south of the Urals, in 1935–37, with notes on their breeding places, abundance, seasonal occurrence, local distribution and in some cases morphology. The only Anopheline found was *Anopheles maculipennis* Mg., and examination of the eggs laid by overwintered females in 1935 showed that all belonged to var. *messeae* Flni., which must therefore be the vector of the malaria that occurs in the district. It had four generations a year and a partial fifth that died out without giving rise to adults. No permanent breeding places were found in the town, but there were many near it, the larvae being particularly numerous in lakes and the shallows that formed in summer in the river Ural, which were overgrown with aquatic vegetation. Oiling sites covered with pond-weed (*Potamogeton*) killed all larvae and scorched the plants so that they did not recover for ten days or more, during which no further larvae appeared. Cutting down or pulling out the plants gave good control, but was much more costly. Females with developed fat-body first occurred in mid-August, and they entered hibernation in September and October, congregating chiefly in cellars, which are usually in courtyards a few yards away from the houses.

Papers noticed by Title only.

Burchfield (H. P.), Hilchey (J. D.) & Storrs (E. E.). **An objective Method for Insecticide Bioassay based on Photomigration of Mosquito Larvae.**—*Contr. Boyce Thompson Inst.* **17** no. 1 pp. 57–86, 7 figs., 12 refs. Yonkers, N.Y., 1952. [See *R.A.E.*, A **42** 76.]

Beck (S. D.). **Effect of Insecticides on the Metabolism and Motility of Mammalian Spermatozoa.**—*J. econ. Ent.* **46** no. 4 pp. 570–574, 9 refs. Menasha, Wis., 1953. [See *R.A.E.*, A **42** 80.]

Johnston (B. L.) & Eden (W. G.). **The Toxicity of Aldrin, Dieldrin, and Toxaphene to Rabbits by Skin Absorption.**—*J. econ. Ent.* **46** no. 4 pp. 702–703, 9 refs. Menasha, Wis., 1953. [See *R.A.E.*, A **42** 97.]

Anderson (R. W.), Blakely (R. M.) & MacGregor (H. I.). **The Toxicity of Aldrin for growing Turkeys.**—*Sci. Agric.* **32** no. 11 pp. 586–591, 5 refs. Ottawa, 1952. [See *R.A.E.*, **42** 75.]

Ross (R. W.), Haddow (A. J.), Raper (A. B.) & Trowell (H. C.). **A fatal Case of Yellow Fever in a European in Uganda.**—*E. Afr. med. J.* **30** no. 1 pp. 1–11, 2 pls., 16 refs. Nairobi, 1953.

Reported deaths from yellow fever are very uncommon in East Africa, although antibodies in man and animals are widely distributed. An account is given of the case history of a European who died in Kampala, Uganda, of yellow fever contracted at Kasunganyanja in Bunyangabu (Toro District) early in January 1952, together with the results of post-mortem examinations and accounts of the findings of serum antibodies in his blood. Attempts to isolate the virus were unsuccessful, presumably because he did not die until the seventh day of illness. The surroundings of the camp where he lived and mosquito catches made near it in and immediately after the end of January are described. Immunity was found in monkeys (*Colobus polykomos uellensis*) in nearby forest and in 13 of 47 persons of whom the majority had apparently acquired it locally. January was very dry in Toro, and the numbers of mosquitos were at a minimum and had probably been so early in the month. No adults or larvae of *Aëdes aegypti* (L.) or adults of *A. simpsoni* (Theo.) were found, but larvae of *A. simpsoni* and five adults of *A. africanus* (Theo.) were collected. One of the latter was taken biting at ground level by day in a plantation very close to the camp, three were found at ground level by day in a belt of forest in which mosquitos were abundant and one was taken biting just after sunset in the trees. The finding of these adults in dry weather indicates that *A. africanus* would probably be very prevalent when conditions became favourable [*cf. R.A.E.*, B **40** 79]. The very open canopy is thought to be the cause of its appearance at ground level during the day, owing to the penetration of sunshine and wind. In such circumstances, it may feed at ground level and might occasionally transmit yellow fever to man [*cf.* **41** 161].

Hayashi (H.). **On the causative Agent of Tsutsugamushi Disease isolated from Field Voles, *Apodemus speciosus speciosus*, inhabiting the Foot Area of Mt. Fuji in Japan.**—*Kitasato Arch. exp. Med.* **23** no. 3 pp. 13–19, 2 figs., 9 refs. Tokyo, 1951.

Fukuzumi (S.) & Obata (Y.). **A new Species of Trombiculid Mites from Vicinity of Yokohama in Japan.**—*T. c.* no. 3 pp. 79–81, 1 fig., 4 refs. **A new Species of Trombiculid Mites from Kanagawa Prefecture in Japan.**—*T. c.* no. 4 pp. 5–9, 3 figs., 6 refs.

Fukuzumi (S.), Obata (Y.) & Kagiwada (R.). **On the Trombiculid Mites and *Rickettsia* discovered in the Mt. Fuji Foot Plain.**—*T. c.* no. 4 pp. 11–22, 9 figs., 7 refs.

The first and fourth of these papers deal with investigations in the neighbourhood of Mount Fuji in south-eastern Honshu where cases of tsutsugamushi disease occurred in man in 1948 [*R.A.E.*, B **40** 16]. In the first, the isolation by mouse passage of *Rickettsia orientalis* (*tsutsugamushi*) from field mice (*Apodemus speciosus*) taken in August 1949 and February 1950 is recorded, and the situations where the infected animals were found are defined. It is recorded in the fourth paper that in early November 1949, several hundred Trombiculid mites were obtained from *A. speciosus*, *Microtus montebelli* and *Mustela itatsi* caught on the south-eastern slope of the mountain, and *R. orientalis* was isolated from one individual of *A. speciosus*. The soil and vegetation at the three catching stations used are described. Most of the mites were taken at a station at which the soil was alluvial and conditions resembled those in northern Japan where the disease

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is prevalent. *Trombicula akamushi* (Brumpt) was not found. The predominant species was *T. scutellaris* Nagayo et al., and others were *T. fuji* Kuwata et al., *T. pallida* Nagayo et al., and one tentatively identified as *T. japonica* Tanaka et al. All were taken on *Apodemus*, all except *T. pallida* on *Microtus* and all except *T. fuji* on *Mustela*.

The occurrence of a case of tsutsugamushi disease in the Yokohama area in November 1949 and the isolation of the rickettsia from an individual of *A. speciosus* are recorded in the second paper. Twelve Trombiculid larvae found on this field mouse proved to belong to a previously unknown species, which is described as *T. kitasatoi*, sp. n.

In the third paper, *T. miyajimai*, sp. n., is described from six larvae taken on *A. speciosus*, together with four of *T. kitasatoi* Fukuzumi & Obata, near Matsuda-machi between Yokohama and Mount Fuji in Kanagawa Prefecture in October 1950.

Harrison (R. A.). **Tests with Benzene Hexachloride Residues against Houseflies.**—*N. Z. J. Sci. Tech.* **34** (B) no. 2 pp. 134–138, 1 graph, 4 refs. Wellington, N. Z., 1952.

In tests of deposits of γ BHC against females of *Musca domestica* L., deposits five days old of 40 mg. per sq. ft. on glass and painted wood caused complete knockdown within 20 and 120 minutes, respectively, and a deposit of 20 mg. caused complete knockdown in 50 minutes on glass and 75 per cent. knockdown in 150 minutes on painted wood. Deposits of 10, 20 and 40 mg. per sq. ft. on glass gave complete kill after exposure for 20 minutes when two days old, but at nine days old showed little toxicity even with exposure for 80 minutes. Exposure for 20 minutes to deposits of 50 and 200 mg. per sq. ft. on unpainted wood gave complete kill for two and seven weeks, but after these times toxicity fell off very rapidly. The rapid loss of effectiveness is attributed to volatility. Deposits of 60 mg. per sq. ft. on filter papers were reduced to less than 10 mg. in a week.

Saccà (G.). **Esperienze d'incrocio fra** *Musca domestica* **L.,** *Musca vicina* **Mq.,** *Musca nebulo* **F.** [Experiments on the Crossing of *M. domestica*, *M. vicina* and *M. nebulo*.]—*Riv. Parassit.* **12** no. 1 pp. 47–52, 9 refs. Rome, 1951. (With Summaries in English and French.) Also in *R. C. Ist. sup. Sanit.* **14** pt. 11 pp. 937–943, 9 refs. Rome, 1951. (With Summaries in English, French and German.) **Contributo alla conoscenza tassonomica del "gruppo"** *domestica* **(Diptera, Muscidae).** [Contribution to the taxonomic Knowledge of the *domestica* "Group".]—*Riv. Parassit.* **14** no. 2 pp. 97–114, 3 figs., 12 refs. Rome, 1953. (With a Summary in English.) Also in *R. C. Ist. sup. Sanit.* **16** pt. 7–9 pp. 442–464, 4 col. pls., 3 figs., 12 refs. Rome, 1953. (With Summaries in English, French and German.)

Crossing experiments with typical *Musca domestica* L. and two closely related house-flies are described in the first of these papers, and the results of examination of thousands of preserved specimens and several living strains of these and a fourth type from various parts of Europe, Africa and Asia are dealt with in the second. The three forms considered in the first paper (*domestica* L., *nebulo* F. and *vicina* Macq.) are there treated as separate species, but in the second, in view of the results obtained and intervening work by other authors [*cf. R.A.E.*, B **42** 29], they and *cuthbertsoni* Patt. are considered to be varieties of *M. domestica*.

One of the three groups of crossing experiments described in the first paper was made with *domestica* from Denmark and England crossed, respectively, with *vicina* from Algeria and Egypt. All the crosses were

fertile. In another group, with *domestica* from Denmark and *nebulo* from India, six crosses between males of *domestica* and females of *nebulo* were all fertile, but of 16 crosses between males of *nebulo* and females of *domestica*, six resulted in fertile eggs and ten in sterile ones. Crosses between males of *nebulo* from India and females of *vicina* from Sardinia gave fertile eggs in two cases, sterile eggs in one and no eggs in two. The reverse cross gave fertile eggs in one case, sterile eggs in three and no eggs in one. Indian *nebulo* males and females of *vicina* from Egypt gave fertile eggs in three crosses and sterile eggs in two. Four of the reverse crosses gave fertile eggs and one gave sterile eggs. Offspring of all the crosses were completely fertile for at least two generations.

The following is based on the author's summary of the second paper. It seems very difficult to determine the relationship between *domestica*, *nebulo*, and *vicina*. Many intermediate forms exist between the two extremes (*domestica* and *nebulo*), of which the North African *vicina* is one. The number of forms is uncertain, as their limits are ill defined. As exchanges of genes are certainly frequent, it is probable that each population maintains its individuality because the local factors of climate and environment effect a constant selection on its genetic constitution. This hypothesis is supported by the fact that an Indian strain of *nebulo* reared in Rome for 20 generations became practically indistinguishable from *vicina*. The distinctive characters of the three forms could be somewhat modified by the temperature at which the immature stages developed.

It is usually easy to distinguish *vicina* and *cuthbertsoni*, which have been collected together in several localities of North Africa, but individuals showing intermediate characters can be found. A strain of *cuthbertsoni* from Algeria kept in the laboratory for five generations became progressively more like *vicina*. There is little doubt that these two forms belong to the same species. Their differences may be controlled by genetic or environmental factors or both.

Ascher (K. R. S.) & Reuter (S.). **The physical State and insecticidal Properties of D.D.T. in Spraying Residues. Laboratory Experiments on Glass Plates.**—*Riv. Parassit.* **14** no. 2 pp. 115–122, 17 refs. Rome, 1953. (With a Summary in Italian.)

It has been shown that crystallisation reduces the contact toxicity of DDT for various insects and that the activity of the DDT can be prolonged by keeping it in oil solution [*cf. R.A.E.*, B **40** 109], and this was confirmed by the experiments described in this paper, in all of which females of *Culex pipiens molestus* Forsk. were exposed for five minutes to insecticide deposits on glass plates in such a way that they rested on the treated surface throughout the exposure period. A crystalline deposit of 1 gm. DDT per sq. m. from a 5 per cent. solution in kerosene had practically no effect, and a crystalline deposit of 0·1 gm. γ BHC as lindane from a 0·5 per cent. solution or deposits of 0·2 or 0·4 gm. chlordane (a viscous liquid) from 1 and 2 per cent. solutions had very little. To test the effect of keeping the DDT in solution by means of chlordane, mixtures of DDT and chlordane in ratios of 1 : 3 and 1 : 7 in kerosene were applied at a combined rate of 0·4 gm. per sq. m. The solubility of DDT in chlordane is about 35 per cent. The 1 : 3 and 1 : 7 mixtures gave 30 and 80 per cent. knockdown, respectively, in 24 hours, when the deposits were two days old. With the 1 : 3 ratio, crystals of DDT could already be seen on the plates, presumably because some of the chlordane had volatilised.

To minimise volatilisation of the chlordane, 5 per cent. of white paraffin oil, in which DDT dissolves very sparingly but which is completely miscible

with chlordane, was added to 1:7, 1:3, 1:1 and 3:1 mixtures of DDT and chlordane in kerosene, which were again used at a combined rate of 0·4 gm. insecticide per sq. m. The results are given in tables. The best were obtained with the mixture containing 0·5 per cent. DDT and 1·5 per cent. chlordane, which gave complete knockdown on smooth glass in three hours after two days and in 24 hours for 23 days, and 20 per cent. knockdown in 24 hours after 44 days. When the percentage of paraffin oil was reduced to 2·5, insecticidal action was slightly reduced for the ratios in which the solubility of DDT in chlordane was not exceeded and considerably in the ratios in which it was. The adjuvant properties of the paraffin oil are assumed to be due to reduction in the volatility of chlordane and to improved adhesion. When paraffin oil was replaced by vaseline in the best formulations, results were much inferior.

Experiments in which mixtures containing 0·5 per cent. lindane, 2 per cent. chlordane and 5 per cent. paraffin oil, or any two of these ingredients, in kerosene were applied to give deposits of 0·1 gm. lindane and/or 0·4 gm. chlordane per sq. m. indicated that, owing to its volatility, the effect of the lindane ceases to be apparent after nine days. With two-day-old deposits on smooth glass, the mixture containing all three ingredients gave 100 per cent. knockdown in three hours and the mixtures of chlordane with oil, chlordane with lindane and lindane with oil gave 100, 100 and 90 per cent. in 24 hours, whereas a similar deposit of lindane without adjuvant gave only 10 per cent. The solubility of lindane in chlordane is only 6–7 per cent.

Synergism between DDT and chlordane over a wide range of ratios in space sprays against the house-fly [*Musca domestica* L.] has been demonstrated by Dicke & Paul [**40** 58]. The synergism claimed by Missiroli [**41** 60] for a deposit of 0·5 gm. DDT with 1·5 gm. chlordane per sq. m. may, however, not be real. The effect may have been due to dissolved DDT.

Gramiccia (G.), Garrett Jones (C.) & El Din Sultan (G.). **Spruzzatura a striscie: un metodo più economico di lotta anti-malarica con insetticidi a potere residuo.** [Spraying in Bands: a more economical Method of applying Insecticides leaving toxic Deposits in the Campaign against Malaria.]—*Riv. Parassit.* **14** no. 2 pp. 123–132, 3 figs., 1 ref. Rome, 1953. (With a Summary in English.)

In the spring of 1952, village houses in two areas in northern Lebanon were treated with DDT for Anopheline control. The standard method of application, in which the whole surface of the walls from about three feet above ground level and the ceiling was sprayed, was used in 97 villages in one area, and a new method, designed to economise DDT, in 45 villages in the other. This consisted in applying the spray in horizontal strips one foot wide and one foot apart over the ceiling and walls, except within three feet of the ground; the angles between the walls and the walls and ceiling were thoroughly sprayed so that about 60 per cent. of the total area of walls and ceiling was treated. The spray was a wettable-powder suspension applied to give a deposit of 2 gm. technical DDT per sq. m. Most of the houses treated by the band-spraying method had chimneys, but those in the other treated area did not, so that smoke tended to cover the DDT deposits on the walls in a few months.

Rooms in the treated villages and in control villages across the Syrian border were inspected at intervals of 15 days. Anophelines were not found for a year in the treated rooms, except for a very few in June–July in rooms treated by band-spraying and at the end of the summer in those treated by the normal method, whereas they were present throughout the year in

rooms in the Syrian villages and in some left unsprayed in the treated villages. The total costs of the two methods are compared; there was a 30 per cent. reduction with the new one.

Gramiccia (G.) & El Din Sultan (G.). **Diversa risposta di** *Pulex irritans* **a polverizzazione di DDT e a spruzzamento di DDT emulsificabile in un esperimento pratico.** [Different Reactions of *P. irritans* to Dusts of DDT and Sprays of DDT Emulsion in a practical Experiment.]—*Riv. Parassit.* **14** no. 3 pp. 191–196, 3 figs., 2 refs. Rome, 1953. (With a Summary in English.)

Since *Pulex irritans* L. was numerous in houses in northern Lebanon that had been sprayed during six years with suspensions of DDT leaving deposits toxic to Anophelines [*cf.* preceding abstract], tests were made in 1952–53 to discover the effect of DDT on the fleas. They were carried out in two villages, one of which had not previously been treated with DDT and in rooms in which the families and their animals lived together.

The effectiveness of the treatments was estimated from the numbers of fleas trapped in shallow pans containing water with a film of oil and having a small lamp in the centre that burnt all night; these were placed in treated and untreated rooms nightly or once a fortnight. The first treatments were with a dust containing 10 per cent. DDT, prepared by diluting a wettable powder with talc. It was applied to the floor, the angles between floor and walls, and the beds and bedding on 18th December and 22nd January, and was completely ineffective. There were no appreciable differences between the numbers of fleas taken in the treated and untreated rooms, between the two villages, or between the numbers in the pans used each night or only once a fortnight. An application of an emulsified solution of DDT in xylene was made in the same rooms on 25th February, the floor and walls up to a height of about 20 ins. and the beds and bedding being sprayed at the rate of 2 gm. DDT per sq. m. The number of fleas fell to 0 after three days and no more were trapped for two months. A spray of emulsified xylene without DDT reduced the numbers slightly, but was effective for 2–3 days only. During the anti-malaria campaign of 1953, emulsion sprays of DDT were applied to the floor and lower part of the walls against *P. irritans* at the same time as the suspensions were applied against Anophelines.

It was not known why the fleas were not affected by the wettable powder containing DDT, which had lost none of its effectiveness against Anophelines.

Pielou (D. P.). **The nonmutagenic Action of** *p-p'*-**DDT and** γ-**hexachlorocyclohexane in** *Drosophila melanogaster* **Meig. (Diptera: Drosophilidae).**—*Canad. J. Zool.* **30** no. 6 pp. 375–377, 9 refs. Ottawa, 1952.

The following is taken from the author's summary. To determine whether p,p'DDT or γ BHC cause mutation in *Drosophila melanogaster* Mg., wild-type males were exposed to the DDT in their larval feeding medium or to the vapour of the BHC as adults, and the Muller-5 method of detecting recessive lethal mutations in the X chromosome was used. No evidence of mutagenic action was found.

Hess (A. D.). **The Significance of Insecticide Resistance in Vector Control Programs.**—*Amer. J. trop. Med. Hyg.* **1** no. 3 pp. 371–388, 3½ pp. refs. Baltimore, Md., 1952.

Instances of resistance to DDT and more recently developed insecticides in insects of medical importance throughout the world are reviewed from

the literature and from personal communications made to the authors by various workers. The latter include records of resistance to DDT in house-flies [*Musca domestica* L.] in many widely separated countries, and in *Pulex irritans* L., *Phlebotomus papatasi* (Scop.), *Culex pipiens molestus* Forsk., and possibly *Anopheles maculipennis* Mg. including var. *sacharovi* Favr in Greece, behaviouristic resistance to DDT in *Anopheles darlingi* Root in Argentina, where it is showing an increasing tendency to rest on the outside untreated rather than the inside treated surfaces of dwellings, possible resistance to DDT in *Culex pipiens fatigans* Wied. in the Puerto Cabello area of northern Venezuela where filariasis [*Wuchereria bancrofti*] is endemic, and resistance to DDT, chlordane and BHC in house-flies in Panama.

On the basis of the analysis of field experience in various parts of the world, rates of development of resistance, the extent to which resistance to one insecticide involves resistance to others, reversion of resistant strains, types of resistance (physiological, morphological and behaviouristic), specific differences in susceptibility, importance of operational practices, effects of resistance on life history and vigour and the outlook for the future are briefly discussed.

Knipling (E. F.). **Present Status of Mosquito Resistance to Insecticides.** —*Amer. J. trop. Med. Hyg.* **1** no. 3 pp. 389–394, 12 refs. Baltimore, Md., 1952.

The following is almost entirely based on the author's summary. Several species of mosquitos, including *Culex pipiens molestus* Forsk. (*C. p. autogenicus* Roub.) in Italy and *C. tarsalis* Coq., *Aëdes taeniorhynchus* (Wied.), *A. sollicitans* (Wlk.), *A. nigromaculis* (Ludl.) and *A. dorsalis* (Mg.) in the United States have developed resistance to DDT in localised areas [*R.A.E.*, B **39** 58, 116; **41** 48]. This resistance has been demonstrated in adults of *C. p. molestus*, *A. taeniorhynchus* and *A. sollicitans*, and in larvae of all the five American species and is high enough to make control by means of DDT impractical. Moreover, some of the species have developed resistance to insecticides substituted for DDT, including toxaphene, BHC and aldrin. Resistance to DDT has not yet been demonstrated among natural populations of *Anopheles* [but *cf.* **41** 72], though intensive control operations have been carried out for several years in many areas, but it is possible that resistant strains may develop.

The author believes that the intensive and widespread application of DDT and other insecticides against both larvae and adults is the chief reason for the appearance of resistant strains of mosquitos in certain areas. He suggests that the development of resistance in mosquitos might be delayed by using measures other than the application of insecticides against the larvae and restricting the applications of insecticides against the adults to the smallest localised areas possible.

Decker (G. C.) & Bruce (W. N.). **House Fly Resistance to Chemicals.**— *Amer. J. trop. Med. Hyg.* **1** no. 3 pp. 395–403, 2 graphs, 7 refs. Baltimore, Md., 1952.

The pattern of the development of resistance to DDT in house-flies [*Musca domestica* L.] in Europe and the United States is sketched, and the degree of resistance observed year by year from 1945 to 1951 in Illinois is indicated [*cf. R.A.E.*, B **40** 26]. It had increased about 240 times by 1951. When other insecticides were brought into use, resistance to them

also soon developed, and of the fly samples collected in 1951, 95 per cent. showed resistance to methoxy-DDT (methoxychlor) and about 50 per cent. to γ BHC (lindane) and to dieldrin. Additional data are given confirming that resistance develops slowly at first and then very rapidly [**39** 40] until equilibrium with the toxicant found in the environment of the strain is reached and showing that the course followed in the development of resistance is similar for all the chlorinated-hydrocarbon insecticides studied. Continuous chemical pressure for 6–20 generations is usually needed to develop 5–10 times normal resistance, but resistance may then be doubled, tripled or quadrupled with each of several successive generations and may reach 100–1,000 times normal in 6–20 additional generations. When flies of a strain resistant to DDT are subjected to treatment by methoxy-DDT, γ BHC or dieldrin, intensification begins at once, and a very high degree of resistance is attained in about half as long as in DDT-susceptible flies.

The development of resistance to insecticides in the laboratory is rapid only when the larvae as well as the adults are exposed to them, and exposure of larvae is probably also a factor in the field [**39** 39, etc.], since DDT-resistance appeared first and was intensified most rapidly on farms on which sanitation was relatively poor so that the spraying would have resulted in much contamination of manure and similar breeding media. Analysis of samples of litter from the floors of 12 buildings that had been sprayed with DDT showed that dripping and drift had resulted in their containing 215–448 parts DDT per million. The frequent observation of symptoms of insecticidal poisoning and a high rate of mortality soon after emergence among adult flies reared from field-collected pupae indicated the possible storage of the toxicant in the larval stage. In one instance, these effects were evident for more than three months after a single application of a 0·3 per cent. dieldrin deposit spray.

The authors have maintained that, with no outbreeding, a resistant strain of flies would retain its resistance at a constant level for many generations in the absence of further exposure to the chemical [**39** 40]. This concept is apparently valid genetically, but in cultures having some heterogeneity, the less resistant flies emerge first, and it has been found possible to obtain a rapid decrease or increase of resistance in subcultures by selecting the earliest or latest emerging flies to perpetuate them. Samples of flies reared from individual masses of eggs of the same generation of a DDT-resistant strain have shown differences in resistance of as much as 50 per cent.

Chadwick (L. E.). **The current Status of physiological Studies on DDT Resistance.**—*Amer. J. trop. Med. Hyg.* **1** no. 3 pp. 404–411, 39 refs. Baltimore, Md., 1952.

It has been established that DDT acts on the nervous system and that the primary site of action is peripheral. The involvement of the central nervous elements is less certain; hyperactivity here may be a secondary effect. Similarly, muscular activity is probably a reflex result of the increase in nervous discharge. Respiratory increase also appears to be secondary, though this is less certain. The manner in which DDT produces the observed instability of peripheral nerve is not known, and the relation between this instability and the death of the insect is uncertain. Theories as to the nature of the relationship are cited and shown to be unsatisfactory. Studies on the possible action of DDT on a variety of enzyme systems have generally yielded negative or inconclusive results, except with cytochrome oxidase [*R.A.E.*, B **39** 118], and though partial inhibition of this catalyst by DDT has been demonstrated, proof is still lacking that such inhibition is a significant factor in the mechanism of intoxication.

Ways in which genetic factors can influence resistance in a population are discussed, though little work has been done on this, and opinions on the physiological nature of resistance are reviewed. Particular attention is given to the detoxification theory, which holds the most promise but has nevertheless some discrepancies. It is suggested that detoxification may be connected with biological oxidation-reduction systems such as that of which cytochrome oxidase is a part. The impossibility of devising a satisfactory control programme without thorough understanding of the mechanisms involved in insecticidal action and resistance and the consequent need of intensified basic research are stressed.

ROZEBOOM (L. E.). *Anopheles (A.) earlei* **Vargas, 1943, in Montana: Identity and Adaptation to Laboratory Conditions (Diptera: Culicidae).**—*Amer. J. trop. Med. Hyg.* **1** no. 3 pp. 477–483, 2 figs., 7 refs. Baltimore, Md., 1952.

Unlike other dark-winged North American Anophelines, *Anopheles earlei* Vargas and *A. occidentalis* D. & K. have a coppery spot at the apex of the wing, indicating that they are closely related to the Palaearctic members of the complex of *A. maculipennis* Mg. Vargas [*R.A.E.*, B **34** 100] suggests that *earlei* is found from the New England States to Oregon and Washington [*cf.* next abstract] and that *occidentalis* is restricted to the Pacific Coast. "*A. occidentalis*" has been reported from various localities in Canada and Alaska; presumably most if not all of the Canadian records refer to *A. earlei*.

An account is given of observations made in July 1951 on the identity of the form occurring in Montana on the basis of taxonomic examination, adaptability to laboratory conditions and biological characteristics. Larvae and pupae to establish a colony were obtained chiefly from the margins of a canal with thick vegetation and clear, very cold water. Adults for morphological study were also taken from beneath bridges and on human bait. Rearing methods are described. Morphological characters of associated larvae, pupae and adults showed the mosquito to be *earlei*. The egg differs from that of *occidentalis* in possessing two dark transverse bars on the dorsal surface, which indicate a close relationship between *earlei* and typical *A. maculipennis* of Europe. However, *earlei* mated readily in small cages (647 cu. ins.) [*cf.* **40** 127]. An attempt to establish a colony in Baltimore failed, but this is attributed to inability to send enough eggs and possible failure of the mosquitos to adapt themselves to the different climatic conditions. It is suggested that the separation of *earlei* and *occidentalis* should be clarified by the study of an adequate series of the latter, which may be variable. The Montana specimens were stable in morphological characters, but they may represent an inbreeding population that shows less variation than do *earlei* populations elsewhere.

PRATT (H. D.). **Notes on** *Anopheles earlei* **and other American Species of the** *Anopheles maculipennis* **Complex.**—*Amer. J. trop. Med. Hyg.* **1** no. 3 pp. 484–493, 12 figs., 1 map, 14 refs. Baltimore, Md., 1952.

Literature on the taxonomy of closely related Nearctic Anophelines and particularly that on the basis of which four species of the complex of *Anopheles maculipennis* Mg. (*freeborni* Aitken, *aztecus* Hffm., *occidentalis* D. & K. and *earlei* Vargas) are now recognised in North America, is briefly reviewed, and notes are given on the characters distinguishing the adults, larvae and pupae of these four species. Their distribution is outlined and

shown on a map, which indicates where their ranges adjoin but not where they overlap. The author states that *A. aztecus* is Mexican, *A. freeborni* occurs in the United States west of the Rocky Mountains and in western Texas, eastern New Mexico and south-eastern Colorado, *A. occidentalis* is found along the Pacific coast region, perhaps east as far as the Rockies, and *A. earlei* appears to occur in the northern United States and southern Canada east of the Rockies, its westward range including Wyoming and Montana. The map also indicates that *earlei* does not occur so far west as Washington and Oregon [*cf. R.A.E.*, B **34** 100], and that the only species of the complex found along the Pacific coast in Alaska, Canada and the United States north of Lat. 35°N. is *A. occidentalis*.

A. freeborni feeds on man and is considered an efficient vector of malaria in parts of New Mexico, California, Utah and Oregon [*cf.* **37** 97; **42** 32], and *aztecus* is considered a vector in parts of Mexico [**41** 206]. As *occidentalis* seldom feeds on man, it is thought to be a poor vector in California, and though *earlei* bites man avidly both in sunlight and in houses at night, it is probably of little or no importance in the transmission of malaria, as it is a northern species.

Brown (A. W. A.). **Studies on the Responses of the Female *Aëdes* Mosquito. Part VI. The Attractiveness of coloured Cloths to Canadian Species.**—*Bull. ent. Res.* **45** pt. 1 pp. 67–78, 11 refs. London, 1954.

The studies described in this sixth paper of a series [*cf. R.A.E.*, B **41** 37] were designed to evaluate the attractiveness of fabrics worn by the armed services to the *Aëdes* mosquitos of northern Canada and to investigate the physical principles determining the attractiveness of coloured surfaces to them. Eight dyed flannels, seven coloured satins and 17 service fabrics were tested on robots [**40** 39] and men for their attractiveness to the mosquitos (*A. punctor* (Kirby) and associated species), and the extent to which they reflected visible and ultra-violet light was assessed. Their attractiveness varied inversely with their reflectivity or brightness [*cf.* **37** 79], although differences of texture tended to obscure the generalised relationship. When comparisons were made within a series of identical texture, the correlation was good in the wave-length range from 475 to 625 millimicrons, but was present neither in the red or infra-red nor in the violet or ultra-violet ranges of wave-length. Green tended to be less attractive and white more attractive than was expected from this relationship. For colour values of similar lightness or darkness, the order of attractiveness was black, red, blue, brown, green, white and yellow.

Yeo (D.) & Thompson (B. W.). **Aircraft Applications of Insecticides in East Africa. V. The Deposition in open Country of a coarse Aerosol released from an Aircraft.**—*Bull. ent. Res.* **45** pt. 1 pp. 79–92, 4 figs., 14 refs. London, 1954.

The first four papers of this series were concerned with the application of aerosols in woodland against *Glossina* [*R.A.E.*, B **41** 211; **42** 23]. When an aerosol is released over woodland, its eventual distribution is influenced by atmospheric turbulence in the free air above the canopy and by air movement within the canopy. The latter is a function of the nature and density of the trees and the condition of the free air. Simplification of the many variables is necessary in studies designed to yield ordered knowledge, and those described in this paper were concerned with the deposition on open country of a coarse aerosol (with a mass median diameter of 80 μ)

released from an aeroplane flying at about 30 ft., and formed part of an investigation into the possibilities of applying insecticides from aircraft to control insect pests in East Africa.

The following is virtually the authors' summary. It is shown that the rate at which the aerosol is deposited is greatly affected by the degree of atmospheric turbulence, a practical measure of which is described. The rate of deposition is approximately inversely proportional to the time interval elapsing between production of the aerosol and deposition, except for deposits laid down near the line of emission. Droplets less than 10 μ in diameter are not deposited appreciably within any useful time interval, and it would be most uneconomical to attempt to produce deposits upon the ground by using drop spectra consisting mainly of such small droplets.

The solution used was a 10 per cent. w/v solution of technical DDT in equal parts of Shell Power Kerosene and Shell Diesoline. Evaporation of the volatile constituents takes place very rapidly during the first few seconds after production of the droplets, and deposits formed immediately beneath the aircraft track have lost 50 per cent. of their initial volume. Solvent losses increase significantly with time, but so slowly that for most practical purposes the solution strength of the ground deposit is very nearly constant for all important sampling points.

A general discussion is given of the dosages received by an insect, and it is indicated in a general way that in tropical Africa there are only short periods of daylight during which aerosols may be used most effectively. The ground deposition in open country is only one aspect of the complex problem of aerosol behaviour; other important aspects are indicated.

Wilson (S. G.). **A preliminary Study of the *Glossina pallidipes* Austen Population at Makueni, Kenya.**—*Bull. ent. Res.* **45** pt. 1 pp. 141–161, 17 figs., 6 refs. London, 1954.

The following is the author's summary of work in the eastern part of Machakos District, Kenya. The Makueni fly belt is chiefly infested with *Glossina pallidipes* Aust. and lies between 4,000 and 2,600 feet above sea level. The climate is hot and dry, with two wet and two dry seasons annually. The dry period during January and February is hot with bright sunlight, while during the June to September dry period the temperatures are lower and with dull cloudy periods. The vegetation is *Acacia-Commiphora* dry grassland association with the *Commiphora* especially predominating at the lower altitudes in the east. The non-riverine deciduous bushland and thickets show two leafless periods in the year, corresponding with the dry seasons. A system of regular fly patrols has been in operation in this area since January 1949. The total flies caught show a regular seasonal increase during February–March each year and less regular and smaller increases during June–July and October–November. The same seasonal increases in the fly-populations are shown by the average number of old male flies caught per patrol.

Flies caught during 1951 were fewer than in 1950 in the settled areas and at Thwake camp, but at Kikumeni in the dense *Commiphora-Acacia* thickets the catches in 1951 were at least as numerous as in 1950. Teneral flies formed a greater proportion of flies caught at Thwake camp than at Kikumeni. There was, however, no rise in the number of tenerals caught to correspond with the seasonal increases of total flies caught. The percentage of male flies in catches was higher at Thwake camp than at Kikumeni.

It is suggested that the February–March rise in flies caught is due to a movement of flies inward from the dry bushland to the cooler more shady

riverine areas. At Thabu this movement from *Commiphora* orchard country to shady riverine areas during February 1952 is shown by comparison of the returns from two patrols sited respectively in these two habitats. The movement of fly towards riverine shade is not so marked during the long dry months of July, August and September because the weather is cooler and radiation less intense. The fly "invasion" experienced during the June–October period of 1949 coincided with an abnormally dry hot season and fly moved in abnormal numbers not only inwards to the riverine shade but westwards towards the increased shade to be found in the *Combretum-Dalbergia* association in the settled areas. There may also have been increased activity of *G. pallidipes* at this time. The effects of rainfall and humidity on the distribution of a *G. pallidipes* population is also seen when the total flies caught at Thwake camp during 1950 are compared with those caught during 1951.

Parsons (B. T.). **Field Observations on a Breeding Place of** *Glossina pallidipes* **Austen in Kenya.**—*Bull. ent. Res.* **45** pt. 1 pp. 163–174, 2 figs., 1 ref. London, 1954.

A breeding place of *Glossina pallidipes* Aust. among evergreen shrubs (chiefly *Craibia* sp.) on the Kiangine river, Makueni [*cf.* preceding abstract], was studied between April 1949 and June 1952 by making routine searches for puparia and correlating the findings with records of rainfall and temperature. A fly-patrol was also operated. The surrounding country away from the river banks consisted of thorn-scrub, with *Acacia* and *Commiphora* spp. predominating. Three sites, each of 200 sq. yards and divided into fifty squares, were marked out, and two of them were searched approximately monthly and the third quarterly.

Site "A" was searched nearly every month between April 1949 and June 1952, and all full or empty puparia found were removed. Full puparia were nearly always found, but their numbers varied very widely. Few were found during the wet months (November–January and April–May), but 1950 was an abnormal year with very large numbers in May. A consistently large increase occurred in February, the hottest and driest month, and a rather less marked increase towards the end of the long dry season in September and October. Large numbers of full puparia also tended to coincide with times of low average minimum temperature. The numbers of flies caught on the fly-patrol did not bear a close relation to the numbers of full puparia discovered. Testing for efficiency of searching by means of marked puparia showed that about 40 per cent. of puparia were being recovered, so that results must be taken as relative. Collections that were kept for emergence showed a sex-ratio of about 1 : 1, a pupal period of 35–40 days, and a widely varying percentage of parasitism (principally by *Thyridanthrax* sp.). Squares most favoured for larviposition contained a two-storeyed vegetation cover of *Craibia*.

Site "B" was searched monthly between February 1950 and June 1952, and the full puparia were marked and replaced. The trend of numbers followed that observed in site "A", but totals were generally smaller, perhaps because the site was more open. Remarkable correlation between shade and abundance of puparia occurred in October 1951, when 39 of 50 puparia found were concentrated in 6 sq. yards under a group of large *Craibia*. Recoveries of the marked puparia were good, and confirmed that the puparia remained full on the site for 1–2 months. Site "C" was in dense shrub. It was searched only eight times, at quarterly intervals. Very large numbers of empty puparia were removed at the first searches, but there was no significant difference between the totals of full puparia

from this site and from site "A". It was concluded that the more frequent disturbance of the soil in the latter did not have an unfavourable effect on breeding. Flooding of the sites in April 1951 caused a decrease in the fly-population. A concentration of puparia under flood-débris in the following June and July was noted.

It is suggested that the fall in numbers of puparia in the evergreen *Craibia* thickets in the wet season is due to the extensive use of non-riverine thickets of *Combretum exalatum* with *Sansevieria* undergrowth as alternative breeding-places at that time. The increased numbers of predators in damp soil may be an additional factor.

GARNHAM (P. C. C.) & MCMAHON (J. P.). **Final Results of an Experiment on the Control of Onchocerciasis by Eradication of the Vector.**—*Bull. ent. Res.* **45** pt. 1 pp. 175–176, 3 refs. London, 1954.

Early in 1946, *Simulium neavei* Roub. was eradicated from the Kodera district in Kenya [*R.A.E.*, B **35** 109–110], where it was the vector of *Onchocerca volvulus*, by the treatment of streams with DDT. Surveys made at least annually in the following seven years failed to yield a single adult, and 1,200 crabs from the Kodera rivers were examined in 1950 for the immature stages [*cf.* **40** 5] with negative results.

No microfilariae were found in 21 children under four years of age examined in 1950 or in 36 examined in 1953. Amongst children estimated to be 4–8 years old when examined, six out of 120 showed microfilariae in June 1953 (5 per cent. as compared with 37 per cent. of those examined in 1947), but it is possible that some of these children were older. Of 129 children less than eight years old examined in September, none showed microfilariae. The rate in adults fell from 70–85 per cent. in earlier surveys to 50·3 per cent. in 1953. This indicates that adult worms can survive and produce microfilariae for at least seven years.

HADDOW (A. J.). **Studies of the Biting-habits of African Mosquitos. An Appraisal of Methods employed, with special Reference to the twenty-four-hour Catch.**—*Bull. ent. Res.* **45** pt. 1 pp. 199–242, 11 figs., 2½ pp. refs. London, 1954.

A general account is given of the author's studies of the biting habits of mosquitos frequenting native huts in Kenya in 1940–41 [*R.A.E.*, B **30** 182] and of species found in banana plantations and in rain-forest in Bwamba County, Uganda, from 1942 to 1948 [**40** 1; **41** 10, etc.] and in small forest areas near Entebbe from 1946 to 1948. In the Uganda work, catches were made over complete 24-hour periods [**33** 189]. Brief reference is made to the use of 24-hour catches by other workers in Africa and elsewhere. The technique of making these catches is then described in detail, and procedure, difficulties and interpretation of results are discussed. Points dealt with include the number of persons acting as bait, catching and sorting procedure, timing, the durations and grouping of catches, the use of measures of the central tendency in analysis, the main types of biting-behaviour found (a short or a prolonged period of activity), the biting-cycle in relation to differences of level, locality and season, and to the estimation of seasonal incidence and vertical distribution, the influence of meteorological factors, the possibility that different sections of the population bite at different times, and the impulse to bite.

The following is based on the author's summary and conclusions. Deductions on seasonal abundance, vertical distribution and times of biting-activity must be based on 24-hour catches if serious errors of interpretation

are to be avoided. The time-divisions of the catch should not exceed one hour, and timing should be related to the actual times of sunrise and sunset. A series of consecutive catches is desirable, and a shift system, which should be worked out in relation to the particular series, must be used to counteract individual differences in attractiveness. Usually, the results from different levels, and preferably those from different seasons or localities also, should be treated separately in working out biting-cycles, and while in some instances the summation of long series of catches seems permissible, in others it is not, and detailed analysis of the figures may be necessary before consistent behaviour-patterns become apparent. Where a measure of the central tendency is to be used, a modification of the geometric mean, proposed by C. B. Williams [A **25** 656] for employment in series that may include zero values, is considered the most suitable.

The author no longer holds the view that the biting behaviour of mosquitos in the field is actively conditioned by the microclimate [**33** 190], but suggests that the impulse to bite is inhibited by unfavourable microclimatic conditions. After the restoration of favourable conditions has made biting possible, the biting-pattern that ensues is apparently related more to separate groups in the female population than to the influence of the environment. Current work by the author has shown that females of several species bite at a constant stage early in the ovarian cycle. Apparently, the impulse to bite is not the same in all species. Some seem to respond to visual stimuli. Some come to bite in small waves at short intervals. No explanation for this has been found.

Omori (N.) & Fujii (S.). **On the Feeding Habits of** *Aedes togoi* **and some other Species of Mosquitoes.**—*Yokohama med. Bull.* **4** no. 1 pp. 23–31, 6 refs. Yokohama, 1953.

Aëdes togoi (Theo.) can be infected with *Wuchereria bancrofti* [*R.A.E.*, B **16** 67; **25** 98] and can transmit Japanese B encephalitis [*cf.* **40** 163], but records of its feeding habits in Japan, where it is widely distributed, are contradictory. LaCasse & Yamaguti [**42** 33] considered that it is of little importance as a vector of disease, because it was taken only once during extensive collections of mosquitos attacking man made by day and night over a period of four years. They suggested, however, that their observations do not exclude the possibility that man may be readily attacked by a form of the species that breeds in salt water, which they consider to be a morphologically indistinguishable variety [*cf.* also **37** 147]. Accordingly, an investigation was made in 1951 of the feeding habits of the species on the islet of Oshima off the coast of Fukui Prefecture in west-central Honshu, where it breeds extensively in tide pools behind a reef. The islet is uninhabited at night, but in the warm seasons there are the staff of a refreshment house and sightseers by day. Mosquitos were collected hourly throughout the night and sometimes parts of the day in man-baited traps operated once a month from May to October. *A. togoi* comprised 88 per cent. of the 2,681 female mosquitos caught, which included eight species. It was taken in each month, but was most abundant in June and July. Females appeared to feed at any time throughout the 24 hours with a main peak 1–4 hours after sunset and a secondary one just after sunrise. Larvae were taken from May to August and were most numerous in June. Only one other species appeared to be breeding on the islet.

At inland places in Fukui Prefecture, females of *A. togoi* were rarely seen in houses or cattle quarters. However, at a fishing village in Nagasaki Prefecture where *A. togoi* breeds both in tide pools and in rain-water containers, the density of the larvae in the containers increased with proximity

to the sea, so the salt-water and fresh-water forms are apparently identical. Density in the tide pools was not affected by distance from the village, and in spite of the proximity of very large numbers of immature stages in tide pools, females rarely bit man by day; they did so by night to some extent, but showed a preference for cattle. It is assumed that the larvae of *A. togoi* can tolerate a wide range of salinity and that although the females seem to prefer cattle, they will bite man readily in areas where they are abundant and cattle are not [*cf.* **27** 158].

Macdonald (G.). **The Analysis of the Sporozoite Rate.**—*Trop. Dis. Bull.* **49** no. 6 pp. 569–586, 3 graphs, 63 refs. London, 1952.

The following is virtually the author's summary. The factors that influence the sporozoite rate in human malaria (percentage of females of a given species of *Anopheles* having sporozoites in the salivary glands) are examined independently, and some of the literature concerning each of them is briefly reviewed. They are the infectivity of man, the duration of the extrinsic cycle of the parasite, the susceptibility of the mosquito to infection, the frequency with which it bites man, and the length of its life. It is suggested that mosquito mortality normally assumes the form of a geometric progression, the death rate remaining materially unchanged with age. On this basis, formulae are given for the probability of survival through given periods, for the expectation of life, and for the expectation of life after survival through a given number of days.

The factors are brought together to show how they are related to each other in their influence on the sporozoite rate, for which a formula is presented. It is accompanied by a table to facilitate its working in practice, and by a figure showing in a series of graphs the relation between the frequency of infective feeds and the sporozoite rate, for varying lengths of life but for one duration of extrinsic cycle only.

The theory so developed is compared with a series of malariometric data collected in South India, and it is concluded that the two belong to the same universe. Some data from other areas are examined, and approximate deductions are made on the length of life of the local vectors.

It is suggested that survey techniques need modification to include measurement of these factors, which are of prime importance in the epidemiology of malaria.

Bouillon (A.). **Les anophèles de Kalenda (Kasai) (Congo belge) (systématique-écologie).**—*Rev. Zool. Bot. afr.* **47** fasc. 1–2 pp. 48–51, 1 ref. Tervuren, 1953.

Larvae of nine species of *Anopheles* were collected in 12 different breeding places within a radius of two miles at Kalenda (Kasai) in the southern Belgian Congo between June 1951 and April 1952, inclusive. Lists are given of the species that occurred together in each of the nine breeding places in which two or more were found. *Anopheles funestus funestus* Giles, which occurred in all the breeding places, and *A. gambiae* Giles, which occurred in four of them, formed about 52 and 5 per cent. of the larvae taken. Adults of *A. funestus* were about ten times as numerous as those of *A. gambiae* in dwellings. The only other Anopheline recorded from them is *A. nili* (Theo.), of which three engorged females were taken in huts about 100 yards from the only breeding-place in which its larvae were found.

DeLong (D. M.) & Boush (G. M.). **Is the Housefly being replaced by other Diptera as the major Insect Pest of Food Markets?**—*Ohio J. Sci.* **52** no. 4 pp. 217–218. Columbus, Ohio, 1952.

Observations made in towns and cities in Ohio, New York, Pennsylvania, West Virginia and Illinois over a period of three years indicated that, contrary to general belief, flies other than *Musca domestica* L. are dominant in food markets. Data are given on the species composition of 16 samples of dead flies swept up from window ledges following treatment of food shops in 16 towns in Ohio with insecticidal fogs in July–September 1951. There were 3,018 flies in all, of which 66·1 per cent. were *Lucilia* (*Phaenicia*) *sericata* (Mg.), 28·9 per cent. *M. domestica* and 5 per cent. *Phormia regina* (Mg.). *M. domestica* comprised over 50 per cent. of only one sample, over 40 per cent. of four others and less than 7 per cent. of three.

Frank (J. F.). **A Note on the experimental Transmission of Enterohepatitis of Turkeys by Arthropods.**—*Canad. J. comp. Med.* **17** no. 5 pp. 230–232, 3 refs. Quebec, 1953.

Experiments to ascertain whether insects could act as mechanical carriers of the embryonated eggs of the caecal worm, *Heterakis gallinae*, were undertaken because these eggs are considered to be the means by which the protozoa [*Histomonas meleagridis*] causing enterohepatitis in turkeys are transmitted in the field. Some years ago, the author found that flies (*Musca domestica* L. and *Lucilia* sp.) that had fed on a suspension of the eggs in syrup left some of them on slides covered with clear syrup on which they subsequently fed. Since turkeys eat large numbers of grasshoppers [*R.A.E.*, B **34** 137], the part they might play in disseminating the eggs was investigated. Grasshoppers of several species obtained from different parts of Canada were used; they were fed on lettuce sprinkled with a culture of embryonated *Heterakis* eggs, killed after various periods ranging up to 96 hours, and then dissected or fed to turkeys. The dissections showed that 13 out of 24 grasshoppers killed after four hours contained at least 1–48 eggs in the intestinal tract, and that some retained the eggs for 96 hours. The feeding experiments were made with a total of 23 turkeys, and all except one of them became infected with enterohepatitis. Most of them were fed on lots of about 50 grasshoppers, but two developed the disease after being fed on only two and three grasshoppers respectively. Grasshoppers killed 96 hours after ingesting the eggs were infective.

Lamb (K. P.). **The Tropical Rat Mite, *Bdellonyssus bacoti* (Hirst, 1913), attacking Man in New Zealand.**—*N. Z. med. J.* **51** no. 285 pp. 320–322, 1 fig., 13 refs. Wellington, N.Z., 1952.

Bdellonyssus bacoti (Hirst) attacked man in two Auckland offices in March 1952. A good series of specimens was obtained from them, and one example, taken in the same month, was received from Port Chalmers, Dunedin. Four specimens from Auckland were found in a collection, two taken in 1946 and two " causing itching in man " in 1950. All the New Zealand specimens were females. A description based on the local material is given, and data on the mite are briefly reviewed from the literature. The infestation of the staff of one of the offices occurred a few days after the premises had been fumigated with hydrogen cyanide to destroy rats, which are the principal host of the mite. Kerosene sprays gave moderately good control in one office.

PHILIP (C. B.). **Tick Transmission of Indian Tick Typhus and some related Rickettsioses.**—*Exp. Parasit.* **1** no. 2 pp. 129–142, 24 refs. New York, N.Y., 1952.

The strain of Indian tick typhus used in the experiments described was originally isolated from five examples of *Rhipicephalus sanguineus* (Latr.) collected in Kashmir in the house of a man who had had a typhus-like infection following tick-bite; it had been maintained by repeated passage in guineapigs in the laboratory in Montana. Experiments on its transmission by *R. sanguineus* were begun by feeding adults, larvae and nymphs from an uninfected laboratory stock on four guineapigs of the 17th passage; a test after 55 days showed that three of the donor guineapigs were completely immune from a virulent strain of Rocky Mountain spotted fever and the other one from a Morocco strain of Marseilles fever. The infection was transmitted by nymphs and adults infected in the preceding stage and by larvae from eggs laid by infected females. In comparative experiments with *Dermacentor andersoni* Stiles, in which a guineapig of the third passage was the donor, no infection of, or transmission by, the ticks was obtained.

Experiments that have been carried out at the same laboratory with Marseilles fever and South African tick-bite fever are also briefly described. It is concluded from them that *D. andersoni* is a less effective vector of either than is *R. sanguineus*, though some enigmatic results were obtained with both ticks.

The interrelationships of these and other tick-borne spotted fevers is discussed, and some of the literature on the latter is reviewed. Some consider that *Rickettsia conori* is a variety of *R. rickettsi* [*cf. R.A.E.*, B **28** 252], since Marseilles fever differs little from Rocky Mountain spotted fever except in its epidemiology and lower severity and the failure of the spotted-fever vaccine to protect against it. The author points out a possible additional difference in that *R. conori* has often been transmitted by injection of unfed active stages of *Rhipicephalus*, whereas it has been reported that *Rickettsia rickettsi* requires reactivation by a fresh blood-meal to become infective [**11** 89]. Both rickettsiae have, however, been transmitted by injection of eggs of their vectors. It is concluded that Indian tick typhus is closer to Marseilles fever than to Rocky Mountain spotted fever [*cf.* **9** 214; **36** 189], that the strain under study was doubtfully distinct from *R. conori* even in a varietal sense, and that the vector is *Rhipicephalus sanguineus*, though this tick very seldom attacks man in any other parts of its range except the Mediterranean basin, where it commonly does so.

PAPERS NOTICED BY TITLE ONLY.

POMERANTSEV (B. I.). **Arachnoidea Vol. IV, no. 2. The Ixodid Ticks (Ixodidae)** [of U.S.S.R.]. [*In Russian.*]—*Fauna SSSR* N.S. no. 41, 224 pp., 638 figs. Moscow, Zool. Inst. Akad. Nauk SSSR, 1950. Price 17 *rub.*

GRUNIN (K. Ya.). **The Larvae of the Bot-flies** [Oestrids, *sens. lat.*] **of domestic Animals of the U.S.S.R.** [*In Russian.*]—*Opred. Faune SSSR* no. 51, 124 pp., 139 figs. Moscow, Zool. Inst. Akad. Nauk SSSR, 1953. Price 7 *rub.* 95 *kop.*

KNIGHT (K. L.) & MARKS (E. N.). **An annotated Checklist of the Mosquitoes of the Subgenus** *Finlaya*, **Genus** *Aedes*.—*Proc. U. S. nat. Mus.* **101** no. 3288 pp. 513–574, 20 refs. Washington, D. C., 1952.

Taylor (R. M.), Mount (R. A.), Hoogstraal (H.) & Dressler (H. R.). **The Presence of *Coxiella burnetii* (Q Fever) in Egypt.**—*J. Egypt. publ. Hlth Ass.* **27** no. 4 pp. 123–128, 20 refs. Cairo, 1952.

Taylor (R. M.), Rizk Hassan (F.), Abdel Kader (M.) & Strome (C. P. A.). **Q Fever in Egypt as revealed by the Complement Fixation Test on Human Sera (a preliminary Report).**—*T. c.* pp. 129–140, 6 refs.

The isolation of *Rickettsia* (*Coxiella*) *burneti* from two batches of ticks collected on animals at the Cairo municipal abattoir during a survey for viruses and rickettsiae in blood-sucking Arthropods in Egypt is recorded in the first paper. One of these batches comprised 54 examples of *Hyalomma dromedarii* Koch from camels and the other comprised 12 examples, collected from bulls imported from the Sudan, of the tick known as *H. excavatum* Koch in the classification of Delpy.

In the second paper, reference is made to an investigation in which complement fixation with a Q fever antigen in serum dilutions of 1 : 32 or above was obtained in 9·2, 6·5, 26·7 and 33·3 per cent. of blood samples from cows, sheep, goats and gamooses [water buffalos], respectively, from the Cairo abattoir, and an account is given of a survey, made by means of the complement fixation test, of Q fever in the human population along the Nile Valley from Aswan to the Delta. Among 487 sera from Cairo, Aswan and seven villages in five provinces, 20 per cent. were positive in dilutions of 1–8 and above and were distributed among all localities. In one village in a sixth province, which was studied more intensively, 39 per cent. of 178 sera were positive, and of 52 sera from children under five years of age from neighbouring villages, 54 per cent. were positive. Both percentages of positive sera and titres were higher in children under five than in older people and the percentages in each age group were higher in females than in males. It is thought that this may be due to the habit of keeping domestic animals in dwellings in close association with the family, so that women and children, who spend more of their time indoors, have more opportunity to acquire infection from the animals, their excreta and stable dust.

Collins (D. L.) & Nardy (R. V.). **The Development and Application of Spray Procedures for controlling the Tick *Dermacentor variabilis* Say.**—*Circ. N. Y. St. Mus.* no. 26, 37 pp., 21 figs. (2 fldg.), 2 refs. Albany, N.Y., 1951.

The methods used to test acaricides for the control of *Dermacentor variabilis* (Say), on Long Island in 1945 and 1946 [*R.A.E.*, B **35** 129; **37** 204] were not precise enough for comparison of dosages and formulations. Two spray-towers for this purpose are described. Both involve the use of "tick corrals", each of which has a wire-screen base and consists of three concentric enclosures of wire screen, with diameters of 1, 3 and 5 ins. and fences $\frac{3}{8}$, $\frac{5}{8}$ and $1\frac{3}{4}$ ins. high, respectively. The ticks are put in the central enclosure and it takes longer for them to climb all the fences than for the spray to settle, so that all are equally and fully exposed to the spray. The first tower was made by centering a stove pipe over a hole in the top of a drum in which a corral was placed on a wire support. A glass slide with an oleophobic surface was put under it to test the uniformity of the deposit. The spray solution was atomised into the top of the stove pipe and allowed to settle for two minutes, after which the corral was removed and the ticks were transferred to tubes containing moist sand and dry straws. A very

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uniform deposit was generally obtained. The second tower was a shower-bath stall with walls 7 ft. high and 4 ft. wide and a foot of space between the top of the walls and the ceiling. Five corrals with a slide under each were put on the floor for each experiment, and two minutes were allowed for the spray to settle. Data from one of these tests is given in detail, with photographs of the slides. A 2 per cent. solution of γ BHC in fuel oil was used and killed 42, 64, 100 and 100 per cent. of the ticks when applied at rates of 0·5, 1, 2 and 4 cc. per sq. yard. An application of 2 cc. per sq. yard is equivalent to about 2·5 U.S. gals. [or 0·4 lb. γ BHC] per acre. Deposit patterns were uniform for the different replicates of each experiment, and deposits were clearly correlated with kills. A comparison of the results of several such tests showed that there were no significant differences in original mortality figures between 2 per cent. γ BHC, 2 per cent. aerosol-grade DDT and 2 per cent. technical DDT at 1·25 U.S. gals. per acre.

Semi-field tests made with DDT in 1947 under cages covering one square yard of grass and stocked with 100–400 ticks showed no significant differences in the results given by solutions, emulsions of solutions, suspensions and dusts, and emulsions were chosen for the field tests as they have practical advantages. In 17 experiments of spraying of roadsides and paths [*cf.* **29** 137] in 1948, DDT was applied at 1·5–5 lb. per acre, BHC at 0·09–1 lb. γ isomer and chlordane at 2·75 lb. The lowest dosage of DDT immediately reduced populations almost to zero but allowed them to increase to as much as half their former size in ten days. After a second application at the same rate, populations again fell almost to zero and remained very low for the rest of the season. One spraying with 5 lb. per acre was found in 1949 to be as effective as two with 1·5 lb. Chlordane and BHC at the highest dosages were less effective than DDT, both in immediate and lasting action.

A test on a regional scale was made in 1949 on an island with an area of 11·5 sq. miles. The specially designed apparatus consisted of a tank with a capacity of 42 U.S. gals. mounted on a jeep and having a compressor adjusted to maintain an air pressure of 40 lb. per sq. inch. Spray was delivered through flat-spraying nozzles on four booms (three rigid and one adapted for spot treatment), each of which could be operated independently. The whole width of a narrow grass-grown roadway could be sprayed at once or each edge of a wider road in turn. The jeep was driven at 10 miles per hour to give a dosage of 9·6 U.S. gals. containing 4·3 lb. DDT per acre. All accessible roadways and grassy tracks were sprayed, except on one estate that had been recently burned over and was mostly free from ticks. One complete treatment was applied between 30th May and 15th June and a second between 19th and 26th August. It is doubtful whether the second application was necessary as the drop in population that followed it coincided with the normal seasonal decline.

Results were assessed by dragging weekly in areas known to be heavily infested at the outset. The average number of ticks found per 1,000 yards throughout the season was 10·1 as compared with 56·5 in similar control areas. In four sectors in which 200, 30, 155 and 80 ticks were taken at the last observation before treatment, 0, 1, 35 and 2 were taken, respectively, at the first observation after spraying and numbers did not rise substantially during the next 8–10 weeks. The results were similar to those obtained in the previous year in small sectors carefully treated individually with hand equipment. It is concluded that satisfactory control of *D. variabilis* on Long Island on either a local or a regional scale could be obtained with the methods described. Specific recommendations based on the findings are appended.

Breev (K. A.). **The Behaviour of blood-sucking Diptera and Bot-flies when attacking Reindeer and the responsive Reactions of the Reindeer. I. The Behaviour of blood-sucking Diptera and Bot-flies when attacking Reindeer.** [*In Russian.*]—*Parasit. Sborn.* **12** pp. 167–198, 9 figs., 24 refs. Moscow, 1950. **II. Herding together in Reindeer as a Factor in Protection from the Attacks of Blood-suckers and Bot-flies.** [*In Russian.*]—*Op. cit.* **13** pp. 343–354, 31 refs. 1951.

Blood-sucking Diptera and bot-flies cause serious losses of reindeer in the north of the Soviet Union, and the first part of this paper comprises an account of investigations on their behaviour, carried out in 1946–48 in tundra on the left bank of the Pechora (European Russia). In studies of frequency, the insects were collected from a tethered reindeer by placing a bell-shaped cover over it, or were counted as they alighted on different parts of its body. The species observed comprised six mosquitos, ten Simuliids, 15 Tabanids, and the bot-flies, *Hypoderma* (*Oedemagena*) *tarandi* (L.) and *Cephenemyia trompe* (Modeer).

Simuliids, mosquitos and Tabanids made up about 92, 7 and 1 per cent. of the blood-sucking Diptera counted on the reindeer and about 87, 76 and 87·5 per cent. of them respectively, settled on the belly and legs, these being the parts on which the hair is sparsest and most recumbent. They were readily attracted to a rough model of a reindeer covered with hide, even when this was covered with black material, but not when it was covered with white material, so that visual stimuli appear the main factors in attraction. A loose reindeer hide and a black raincoat also proved attractive, which showed that the flies had little perception of differences in shape or size. The distribution of the flies on the model was similar to that on the living animal, but when the model was suspended upside down at some distance from the ground, they congregated on the back, neck and antlers, which were then the least illuminated parts, the light intensity to which they were exposed ranging from 20 to 8,875 lux as compared with 340–35,500 lux for the upper parts. This indicated that the attraction to the lower parts of the body is due to a tendency to fly to the darker, shaded parts of any object that contrasts with its background. Further experiments, in which the back and abdomen of a reindeer and the model were left uncovered or were alternately covered with a white or dark-blue material, indicated that horizontal objects affording a sharp tonal contrast, the upper part being light and the lower dark, possessed the greatest attraction for mosquitos and Simuliids, but the mosquitos sometimes concentrated on the illuminated parts and sometimes on the shaded ones, whereas the Simuliids definitely preferred the shaded lower parts.

The bot-flies were also attracted to the model as readily as to the living animal, and in some instances even more so, and it was found that *C. trompe* could distinguish the nose from other parts of the body, apparently by sight. Both species were much attracted to white reindeer hides or to white cloth exposed on the ground, probably because of the sharp tonal contrast.

In the second part, the author discusses the way in which reindeer crowd together in dense groups within a herd as a means of protection against blood-sucking Diptera. Since the latter are attracted to any object that stands out against the landscape, isolated animals are subject to maximum attack, but protection is not afforded by crowding unless a certain minimum number of animals is involved, the number varying with the intensity of attack. Animals that are ill or being used for transport should be protected by smearing with a mixture of 15 parts lysol, 8 parts turpentine and 77 parts water [*cf. R.A.E.*, B **33** 15]. In experiments, this mixture did not

harm the reindeer, its repellent effect lasted for about 36 hours, and during this time it halved the number of mosquitos and Simuliids that alighted on the animal. Treating reindeer with dusts or liquids containing DDT or BHC did not prevent mosquitos and Simuliids from engorging before they showed symptoms of poisoning.

Rubtsov (I. A.). **Contribution to the Biology and Ecology of the Midges (Simuliidae) of Central Asia.** [*In Russian.*]—*Parasit. Sborn.* **13** pp. 328–342, 3 refs. Moscow, 1951.

Observations on Simuliids in Soviet Central Asia, chiefly the mountain regions, in 1942–44, revealed the presence of 26 species. The streams and rivers in which they bred are divided into seven types, differing in ecological and physical characters, and the species associated with each type are recorded. The phenology and behaviour of the Simuliids and the sites of oviposition and of the occurrence of the larvae and pupae in the streams are discussed. Development in large rivers in the plains and foot-hills continued almost uninterruptedly; there were 2–4 overlapping generations a year and adults emerged over a period of 9–10 months, though each species had its own rhythm of development and time of emergence. At altitudes of some 6,500–10,000 ft., development ceased in winter and hibernation occurred, usually in the larval stage. Species associated with cold-water springs probably produced two generations a year, while those in streams well heated by the sun had three or four. In spite of the frequency of breeding places and the abundance of the larvae and pupae, which were as numerous as in Siberia, the Simuliids caused comparatively little annoyance. The need for blood-meals is apparently less acute in the south than in the tundra and taïga, so that the aggressiveness of the Simuliids decreases progressively from north to south. The daily rhythm of activity differed from that observed in Siberia or Europe, the Simuliids being quiescent by day and active only at dawn and dusk. The morphological peculiarities of the larvae, pupae and adults that render them adapted to the ecological conditions of mountainous Central Asia are discussed.

Pavlovskiĭ (E. N.) & Skrŷnnik (A. N.). **Experimental Analysis of the Importance of the different Phases in the Metamorphosis of *Ornithodoros papillipes* in the Transmission of the Spirochaetes of Tick-borne Relapsing Fever.** [*In Russian.*]—*Parasit. Sborn.* **14** pp. 47–55, 9 refs. Moscow, 1952.

The investigations described were carried out in Leningrad in 1949 and 1950 with about 3,000 laboratory-bred examples of *Ornithodoros tholozani* (Lab. & Mégn.) (*papillipes* (Bir.)), which were allowed to feed in different stages on guineapigs infected with various Central Asiatic strains of tick-borne relapsing fever, to determine the importance of the stages in the transmission of the disease. Some of the results of previous observations are included [*cf. R.A.E.*, B **33** 197; **34** 206; **40** 213]. The ticks were kept at 26°C. [78·8°F.] in flasks moistened with a drop of water once a week [*cf.* **41** 185], and infected when necessary by feeding on guineapigs when spirochaetes were numerous in their blood.

In tests with the offspring of infected females, conducted over a period of more than ten years, only five out of 63 batches infected the guineapigs on which they fed as larvae, whereas 18 of the same batches infected those on which they fed as first-stage nymphs [*cf.* **40** 213; **41** 185]. This

indicated that ticks that have inherited the infection rarely transmit it before reaching the nymphal stage. Larvae that had engorged on an infected guineapig could not be induced to feed again before moulting, and those that were removed from the infected host before they had completed the meal and were transferred to healthy guineapigs from 30 minutes to 19 days later did not usually attach themselves and the few that did so did not cause infection. A batch of the same ticks in the first nymphal stage effected transmission. It appears, therefore, that the importance of the larvae in the actual transmission of the spirochaetes is insignificant, though they can acquire and preserve them.

Ticks that had become infected as larvae or nymphs, usually transmitted the infection to guineapigs after the next moult, but a minimum period of time from the infecting feed was necessary before they could do so [*cf.* **34** 206]. This became progressively longer as the nymphs became older, and the shortest periods for second-, third- and fourth-stage nymphs and adults were 27, 43, 152 and 155 days, respectively; sometimes they were considerably longer. In experiments in which infected adult ticks were fed 1–2 at a time on healthy guineapigs, infection resulted in only 7 of 20 tests, and the minimum number of days that elapsed after the initial infective meal was 112. Adults can acquire infection at any age. Thus, examples collected in Tadzhikistan in 1937 and allowed to feed on healthy guineapigs five times during 1938–44 did not infect them, but after the surviving males had fed on an infected animal in 1948 they transmitted the disease to a healthy one in 1949, and in similar tests with a batch from the Pamirs, a female became infected in its 12th year of life in the laboratory.

Breev (K. A.) & Karazeeva (Z. F.). **Materials relating to the Biology of the Warble-fly** *Oedemagena tarandi* **L. Observations on the Periods of embryonic Development and Mode of Life of the first-instar Larvae.** [*In Russian.*]—*Parasit. Sborn.* **14** pp. 95–102, 7 refs. Moscow, 1952.

Details are given of observations on the egg stage and the behaviour of the first-instar larvae of the reindeer warble-fly, *Hypoderma* (*Oedemagena*) *tarandi* (L.), a summary of which was included in a paper already noticed [*R.A.E.*, B **34** 111].

Savel'ev (D. V.). **An Oil Solution of DDT in the Control of the adult Bot-flies** *Hypoderma bovis* **De Geer.** [*In Russian.*]—*Parasit. Sborn.* **14** pp. 103–111, 11 refs. Moscow, 1952.

A field experiment on the control of *Hypoderma bovis* (Deg.) by the use of DDT to destroy the adults was carried out in the Province of Leningrad in 1947, after laboratory tests in 1946 had shown that the flies were killed by contact for 1–2 seconds with pieces of calf hide lightly smeared with 2–10 per cent. DDT in solar oil and that the effectiveness of the material persisted for several days in the open. Two infested herds of cattle were selected for treatment and two as controls, and each was separated from the others by natural features that prevented migration of the flies. Adult flight was expected to begin about the beginning of July, and spraying was begun shortly before this. The spray used was 5 per cent. DDT in solar oil, applied at about 200 cc. per animal, though only half this amount was actually deposited on the body, and nearly half the animals in one of the experimental herds were treated six times at intervals of about ten days between 30th June and 22nd August, and nearly half those in the other, four

times at about 15-day intervals between 25th June and 25th August. The animals were sprayed from both sides with knapsack sprayers as they passed through a race, the spray being directed mainly to the lower parts of the body, and the same individuals were treated on each occasion. Observations were made of the numbers of days on which adults were in flight and of the total periods during which the animals were subjected to attack by them. Both values were considerably lower for the treated herds than for their respective controls, and the treated herds were reported to be much calmer in their behaviour than the others. The warbles were counted in early May of the following year, and it was found that the percentages of animals infested and (in brackets) the numbers of warbles per infested animal were 13·7 (5·4) and 29·2 (1·8) as compared with 65 (9) and 59 (8) in the previous year for the two treated herds, respectively, whereas they were 100 (25) and 63 (6) as compared with 61·9 (13) and 64·3 (11) for their controls. There was little difference between the numbers of warbles on the treated and untreated individuals in the two treated herds, which indicated that the reduction in infestation had not been due to control of the newly hatched larvae.

A second experiment was carried out in 1948, when all the animals in one herd and some of those in another were treated at 15-day intervals with the same spray by being driven through the cloud released from knapsack sprayers by two men standing on either side of a gate, each animal again receiving about 100 cc. spray. Counts of the warbles in April 1949 showed great reductions in the percentages of infested animals and in the numbers of warbles per individual as compared with the controls and with the same herds in the previous year. There was also a marked drop as compared with the previous year in one of the control herds, which was on the other side of a river from one of the treated ones. This is attributed to migration of the flies from one herd to the other and the consequent protection afforded to the untreated animals.

SERDYUKOVA (G. V.). **The Hibernation of the Eggs of *Ixodes ricinus* L. under the Conditions of the Karelian Isthmus.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **81** no. 6 pp. 1171–1173, 1 fig., 10 refs. Moscow, 1951.

Ixodes ricinus (L.) has been stated to overwinter in all stages in the west of the Leningrad region, but little is known of hibernation of the eggs.

Observations were therefore carried out in four of the years between August 1946 and September 1951 in a mixed forest to the west of Lake Ladoga, small cages containing eggs laid by females collected locally from animals being sunk in the litter to depths of 4–6 ins. and periodically observed for hatching. During the four winters involved, the snow cover persisted from November to the end of April and the absolute minimum air temperature varied from −14·8 to −29·9°C. [5·36 to −21·82°F.].

Most of the eggs were obtained in July and August, as the ticks infested the animals chiefly in summer. Of those laid in May and the first half of June, some hatched in September. The others and all those laid in the second half of June completed the greater part of their development and then hibernated, whereas eggs laid later (July–October) overwintered with no external sign of development. Almost all of the overwintered eggs that hatched did so in the following July or August, but whereas mortality was very low among eggs laid in July or later, it was very high among those laid earlier. When eggs laid in summer were kept in the laboratory at 18–23°C. [64·4–73·4°F.], most of those that hatched did so 2–4 months

later, but hatching was protracted and incomplete. Hibernation is thus not obligatory for them, though it appears to reduce mortality.

Munson (S. C.). **Some Effects of Storage at different Temperatures on the Resistance of the American Roach to DDT.**—*J. econ. Ent.* **46** no. 5 pp. 754–760, 16 refs. Menasha, Wis., 1953.

As many insecticides have high lipid affinity, the nature of the lipids of a treated insect might influence their effectiveness. It has been found that the degree of saturation of the total lipids of *Periplaneta americana* (L.) as shown by iodine numbers [the number of grammes of iodine taken up by 100 gm. lipid] is influenced by storage temperature. To determine whether the reaction of cockroaches to DDT would vary with the nature of their lipids, large nymphs of *P. americana* were conditioned for at least two weeks at various temperatures, treated according to body weight with suitable doses of DDT (generally in acetone solution) by external application or by injection, and then kept without food at 23°C. [73·4°F.] until they died. The findings are given in tables, analysed and discussed. Nymphs conditioned at 34°C. [93·2°F.] had relatively saturated lipids with an iodine number of about 60 and were markedly less resistant than those conditioned at 23°C., which had lipids with an iodine number of about 72.

It is suggested that if the differences in lipids and in resistance are connected, DDT may be more toxic in the presence of the more saturated lipids because it is less soluble in them and therefore tends to accumulate at the site of toxic action instead of being taken up in the reserve fats. If this is so, the conditioning temperature must affect the solubility of DDT in the reserve fats more than its solubility or rate of adsorption at some site of lethal action. When doses were heavy, there appeared to be more difference in survival rate earlier in the experimental survival time than late. As the cockroaches were being starved, this may have been due to DDT being released from stored fat as this was used. The hypothesis that the reserve fat competes for DDT could also explain the fact that differences between groups conditioned at different temperatures were greater when DDT was applied externally than when it was injected. It could, moreover, account for a lowered resistance observed in cockroaches conditioned at 17°C. [62·6°F.] for more than two weeks; these cockroaches eat less than those kept at higher temperatures, and are probably deficient, either in total quantity of lipids or in some other factor concerned in resistance.

The lipids of nymphs of the two sexes are saturated to the same degree at the same temperature, but females are more resistant than males. This resistance may be due to their containing slightly more fat [*cf.* next abstract].

Munson (S. C.) & Gottlieb (M. I.). **The Differences between Male and Female American Roaches in total Lipid Content and in Susceptibility to DDT.**—*J. econ. Ent.* **46** no. 5 pp. 798–802, 1 graph, 21 refs. Menasha, Wis., 1953.

The following is based on the authors' summary. Total lipids were extracted from adults of *Periplaneta americana* (L.), and the proportion in females was found to exceed that in males by a small but apparently real amount [*cf.* preceding abstract]. The lipid content was highest in nymphs and day-old adults. It fell rapidly in the first half-week of adult life and slowly thereafter. The iodine numbers of the lipids of adult cockroaches, like those of nymphs, were influenced by environmental temperatures and were essentially the same as those of nymphs at the same temperatures.

The resistance of the cockroaches to DDT showed a high correlation with their lipid content, but there seemed to be a difference in resistance between the two sexes that is not accounted for by a difference in lipid content.

ALPERT (M.). **Substitution of Malathion for Malathon as a coined (generic) Name for the insecticidal Chemical O,O-Dimethyl Dithiophosphate of Diethyl Mercaptosuccinate.**—*J. econ. Ent.* **46** no. 5 p. 797. Menasha, Wis., 1953.

On 27th March 1953, the Interdepartmental Committee on Pest Control approved the name malathion for the insecticidal chemical previously named malathon [*cf. R.A.E.*, B **41** 3]. The change was necessary because of difficulty in the trade-marking of the earlier name.

TASHIRO (H.) & SCHWARDT (H. H.). **Biological Studies of Horse Flies in New York.**—*J. econ. Ent.* **46** no. 5 pp. 813–822, 4 figs., 5 refs. Menasha, Wis., 1953.

Data are given on the bionomics of Tabanids near Ithaca, New York, on the basis of studies made in 1948 and 1949. Some of the work carried out in 1948 was reported in a paper already noticed [*R.A.E.*, B **38** 84]. *Tabanus quinquevittatus* Wied. and *T. lasiophthalmus* Macq. formed 58 per cent. of all Tabanids collected during the two seasons, and these species with *T. sulcifrons* Macq., *T. pumilus* Macq. and *T. lineola* F. together formed 76 per cent. In 1949, temperatures during early May were about 20°F. higher than in 1948 and the flies emerged at least a week earlier. Temperature was high and rainfall low throughout the year. *T. lasiophthalmus* appeared during late May and soon became extremely abundant. It was followed by *T. lineola* and *T. pumilus* and then *T. quinquevittatus*. *T. quinquevittatus* was very much less abundant than in 1948 and had no definite peak period but was fairly plentiful for a month. *T. sulcifrons* appeared in mid-July and was present through most of August but not very plentiful. *T. superjumentarius* Whitney, of which only very few had been seen in 1948, and *T. nivosus* O.S., which was not seen at all in that year, were relatively numerous in 1949. Cattle in poor health were attacked more often than others, larger animals more than smaller ones, and dark ones more than light ones. Observations on the numbers of flies coming to feed on a cow in one day and the weight of recently fed flies led to the conclusion that *T. lasiophthalmus*, *T. quinquevittatus* and *T. sulcifrons* could take, respectively, 352, 59 and 109 cc. blood from an animal in a day. The Anthomyiid, *Hydrotaea tuberculata* Rond., and the Chloropid, *Hippelates pallipes* (Lw.), fed on blood oozing from the wounds made by the Tabanids, and were a considerable nuisance swarming around the heads of the animals.

Tabanid larvae were collected in 1949 from sod samples taken in June, July and September at evenly spaced points in a section of a pasture with a moisture gradient from standing water to dry gravelly loam. The great majority of them belonged to the genus *Tabanus*, and most of these were from soil supporting the semi-hydrophytic *Carex hystericina*, which served as an index plant. Some were found in more swampy soil, but there were only a very few in normal pasture. The larvae identified to species comprised 206 of *T. quinquevittatus* and 40 of *T. lineola* and 24 of *T. lasiophthalmus*. The largest number of larvae of a single species in any square-yard sample was 27 larvae of *T. quinquevittatus*. A limited study of vertical distribution indicated that larvae were not present in any numbers at depths of more than 3–4 ins.

FURMAN (D. P.). **Comparative Evaluation of Control Procedures against the Northern Fowl Mite.**—*J. econ. Ent.* **46** no. 5 pp. 822–826, 2 refs. Menasha, Wis., 1953.

The following is based on the author's summary of this account of continued experiments on the control of *Fonsecaonyssus* (*Bdellonyssus*) *sylviarum* (C. & F.) on fowls in California [*cf. R.A.E.*, B **41** 102]. No method was found that was equally effective under all conditions. In mild weather, infestations in large flocks can be very effectively controlled by the application directly to the birds of a power-spray consisting of a 1 per cent. aqueous suspension of R-242 (Sulphenone) [p-chlorophenyl phenyl sulphone] prepared from a commercially available wettable dust with Triton X-100 added to increase the wetting properties of the spray. Various commercial detergents are effective substitutes for the latter. A pump pressure of 50 lb. with a nozzle producing moderately coarse droplets gives satisfactory penetration between feathers. Adequate wetting of 35–50 birds is obtained with 1 U.S. gal. spray applied by this method. Application with a hand sprayer is effective if the suspension is continuously agitated and the nozzle produces a coarse driving spray. Not more than 35 birds should be treated per U.S. gal. spray. In very cold weather, dusts are preferable to sprays, but they are much more tedious to apply. Sulphenone and di(p-chlorophenoxy)methane (Neotran) as 10 per cent. dusts and 1 per cent. γ BHC were effective when applied by hand. Where fowls are kept in small cages containing one or two birds, treatment may be made rapidly and effectively by applying a 40 per cent. Sulphenone dust with a puff-type duster. Birds that use roosts can be quickly though temporarily relieved of infestations by painting the roosts with nicotine sulphate or, more cheaply, a mixture of equal parts of nicotine sulphate and diesel oil. In tests reported here, Neotran was about as effective as Sulphenone when applied as a dust or as a hand-sprayed suspension. Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] blistered the skin of birds when applied as 3 and 5 per cent. dusts, and occasionally also as a spray suspension; control was effective only at relatively high concentrations. Ovotran (p-chlorophenyl p-chlorobenzenesulphonate) was ineffective as a spray or a dust. A 1 per cent. suspension spray of wettable sulphur was also ineffective.

TAHORI (A. S.) & HOSKINS (W. M.). **The Absorption, Distribution, and Metabolism of DDT in DDT-resistant House Flies.**—*J. econ. Ent.* **46** no. 5 pp. 829–837, 2 graphs, 15 refs. Menasha, Wis., 1953.

This is the end of a paper of which the first part has already been noticed [*R.A.E.*, B **41** 176], and it includes the tables and graph referred to in that part. Larvae of flies [*Musca domestica* L.] of the Bellflower strain completed their development normally when reared on medium containing 0·5 per cent. DDT and contained much unchanged DDT, often far more than the largest amount found in adults that died after topical application, and also very much DDE. They pupated, but many adults could not emerge and others showed DDT convulsions for a time after emerging. Both the contained DDT and DDE gradually disappeared.

When DDT was applied to the head, dorsal thorax, ventral thorax or dorsal abdomen of Bellflower flies and these were examined 24 hours later, most DDT was found in the segment to which application had been made, but there appeared to be a general drift towards the abdomen. The abdomen contained most of the small amount of DDE found. Analysis of outer, inner and nervous tissue dissected from flies at various times after

their treatment showed that the ratio of DDE to DDT in the integument increases linearly with time, and indicated that this tissue is the principal site of formation of DDE. The ratio in interior tissues increased more slowly, and ceased to change after a few days. The amounts of DDT in nervous tissue were too small and uncertain to allow of reasonably accurate calculation of the DDE/DDT ratio. DDE appeared in the haemolymph more slowly than DDT.

It appeared that the presence of DDE in the flies delayed the further conversion of DDT to it, and this was confirmed by a test in which Bellflower flies were treated with 1·5 mmg. DDT, 15 mmg. DDE, or both simultaneously. The DDE alone had no apparent effect, but the flies treated with DDT alone and with DDE also absorbed 1·393 and 1·238 mmg. DDT in 24 hours, metabolised 97·8 and 74 per cent. of it, and suffered 16 and 58 per cent. mortality, respectively.

The marked effect of temperature on the action of DDT on insects [*R.A.E.*, A **40** 345, etc.] was confirmed by tests on Bellflower flies treated with 5 mmg. in which the amounts of the DDT absorbed and metabolised and the mortality of the flies, all in percentages, were 18·4, 85·8 and 74·2 at 13·5°C. [56·3°F.] and 71·2, 87·6 and 1 at 32·5°C. [90·5°F.]. It is evident that the reduction in toxic action at higher temperatures, despite rapid penetration is not due to disproportionately faster metabolism but to some condition by which larger amounts of unchanged DDT can be tolerated in the body.

Pratt jr. (J. J.) & Babers (F. H.). **The Resistance of Insects to Insecticides. Some Differences between Strains of House Flies.**—*J. econ. Ent.* **46** no. 5 pp. 864–869, 24 refs. Menasha, Wis., 1953.

The following is based on the authors' summary. Cholinesterase activity of head tissue, oxygen consumption and mortality response of adult females to DDT were determined in six strains of *Musca domestica* L. susceptible to DDT and three resistant strains. Considerable variation in cholinesterase activity was found among the susceptible strains. It is therefore questionable whether the lower activity occasionally observed in resistant strains has any significance. Differences in oxygen consumption were statistically significant when one susceptible strain was compared with one resistant strain, but were not significant when three susceptible strains were compared with three resistant ones. Six susceptible strains showed considerable variation in mortality when treated topically with DDT.

Tsao (Ching-hsi), Sullivan (W. N.) & Hornstein (I.). **A Comparison of Evaporation Rates and Toxicity to House Flies of Lindane and Lindane-chlorinated Polyphenyl Deposits.**—*J. econ. Ent.* **46** no. 5 pp. 882–884, 1 fig., 5 refs. Menasha, Wis., 1953.

The rates of evaporation of deposits of γ BHC as lindane, a chlorinated polyphenyl (Aroclor 5460) and a mixture of the two from glass surfaces to which they had been applied as solutions in carbon tetrachloride was determined by periodical weighings of the deposits. Lindane deposits lost weight rapidly. Deposits corresponding to 300 and 390 mg. per sq. ft. evaporated completely in 50 and 60 days, respectively. The addition of an equal amount of Aroclor 5460 greatly reduced the rate of evaporation [*cf. R.A.E.*, B **41** 143]. The total loss in this case was only 13·5 per cent. after 149 days, as compared with 9·3 per cent. for Aroclor alone.

Tests were also made of the toxicity of the deposits to *Musca domestica* L.; in these, the flies were exposed for ten minutes and the ratio of lindane

to Aroclor 5460 in the mixtures was 1 : 2. A deposit of 25 mg. lindane per sq. ft. lost toxicity in little more than a week, but 10 and 25 mg. lindane with Aroclor were effective for at least nine and 22 weeks, and 2 mg. lindane with Aroclor gave 81, 100 and 1 per cent. kill after two, three and five weeks, respectively. In tests of fresh deposits, 0·05 and 0·1 mg. lindane per sq. ft. alone or with Aroclor caused no appreciable mortality, but 0·3 mg. lindane with and without Aroclor killed 99 and 35 per cent., respectively, the difference indicating that Aroclor may have a synergistic effect with lindane. A deposit of 25 mg. Aroclor by itself did not kill any flies, even where the period for which they were exposed was prolonged to 50 minutes.

Sullivan (W. N.) & Hornstein (I.). **Concentrations and Exposure Time of Lindane Vapor required to kill Insects.**—*J. econ. Ent.* **46** no. 5 pp. 898–899, 5 refs. Menasha, Wis., 1953.

Experiments to determine the concentration of lindane [γ BHC] in air and the period of exposure to it necessary to kill various insects were made in a Peet-Grady chamber lined with brown paper in which the vapour was dispersed by passing air through a filter treated with 8·3 gm. lindane [*cf. R.A.E.*, B **39** 140] for at least 24 hours. The temperature of the chamber was maintained at 24 or 30°C. [75·2 or 86°F.]. Adults of *Musca domestica* L. and *Aëdes aegypti* (L.) and large nymphs and adults of *Periplaneta americana* (L.) were exposed in it in wire-mesh cages and adults of *Bruchus* (*Acanthoscelides*) *obtectus* Say and *Tribolium confusum* Duv. in open petri dishes for periods depending on their susceptibility. Determination of the concentration of lindane per litre of air [*cf.* **42** 27] showed that it was 0·6 mmg. at 24°C. and 1·19 mmg. at 30°C. (70 and 65·5 per cent. saturation, respectively), and these gave 99 and 100 per cent. kill of *Aëdes* after exposure for two minutes, 90 and 100 per cent. of *Musca* after ten minutes, 96 and 100 per cent. of *Bruchus* after 30 minutes and only 12 and 67 per cent. of *Tribolium* and 21 and 33 per cent. of *Periplaneta* after 60 minutes. Exposure of *Tribolium* for 180 minutes gave 56 and 88 per cent. mortality and of *Periplaneta* for 240 minutes 48 and 72 per cent.

To avoid possible dispersion of solid particles of lindane as well as vapour in the air, tests were also made in a closed cabinet (2·5 × 2·5 × 4 ft.), the walls of which were painted with a solution of 10 gm. lindane in acetone. It was kept closed for a week to let the lindane concentration reach a steady state; 91 per cent. saturation was obtained, and this gave 94 per cent. mortality of *M. domestica* exposed for ten minutes at 27°C. [80·6°F.].

It is concluded that although small flying insects are easily killed with 0·6–1·19 mmg. lindane per litre of air, practical control of *P. americana* and *T. confusum* could probably be obtained only with higher concentrations or longer exposures [*cf.* also **42** 37]. Under practical conditions, concentrations of 0·02–0·2 mmg. per litre effectively controlled small flying insects in long exposure periods, and lindane was deposited in differing degrees on different surfaces to form a toxic residue. It is therefore considered advisable to test a wide range of concentrations of lindane in air and as a residual deposit when evaluating its toxicity to warm-blooded animals.

Brown (J. H.). **A Chicken Mite Infestation in a Hospital.**—*J. econ. Ent.* **46** no. 5 p. 900. Menasha, Wis., 1953.

An infestation by *Dermanyssus gallinae* (Deg.) of the operating room on the top floor of a hospital in southern Alberta was investigated in June 1952. The mites were particularly numerous round a stack pipe leading

through the ceiling into an attic. They had apparently come from sparrows' nests in the attic and migrated in search of food after the sparrows had been excluded from it. The infestation was brought under control by sealing off the hole round the stack pipe and thoroughly cleaning the operating room.

Pontoriero (P. L.) & Ginsburg (J. M.). **An abridged Procedure in the Schechter Method for analyzing DDT Residues.**—*J. econ. Ent.* **46** no. 5 pp. 903–905, 1 graph, 8 refs. Menasha, Wis., 1953.

The following is the authors' summary. A shortened procedure in the technique of the Schechter colorimetric method for analysing DDT insecticides [*cf. R.A.E.*, B **35** 196] was tested in various formulations and spray residues in comparison with the longer, standard procedure. In the shortened method, the ether extraction of the nitrated mixture is eliminated and only the p,p'isomer content is analysed.

The results indicate that the abridged procedure can be used with approximately the same accuracy as the longer technique in estimating p,p'DDT in various insecticide formulations and in spray residues.

Kellen (W. R.). **A Quantitative Sampler for Aquatic Insects.**—*J. econ. Ent.* **46** no. 5 pp. 913–914. Menasha, Wis., 1953.

The use of a dip net for sampling populations of aquatic insects over any considerable period does not give reliable results if the intervals between sampling dates are long enough for sudden changes in the composition of the population to escape observation, and does not sample insects active mainly at night. A trap was therefore used during a long-term investigation of the insects inhabiting sewage-oxidation ponds in California. It consisted of a box, 8 ins. square and 18 ins. long, of eighth-inch plastic screening, and had an inverted screen funnel for entrance at each end. One end was hinged for removal of the catch. The trap was submerged at the collecting site; it is important to submerge it completely, so that the insects that swim into the open ends are drowned before they find their way out and the predacious insects caught do not destroy the others, and to keep the pores of the screen clean of algae or mud.

Despite its small size, the trap can catch large numbers of insects. Those taken in one left in an oxidation pond for a week in July 1952 comprised 2962 Corixids, 35 Notonectids, 690 Hydrophilids and 1216 Dystiscids. A list is given of the 17 species represented in this catch and their numbers.

Babers (F. H.), Pratt jr. (J. J.) & Williams (M.). **Some biological Variations between Strains of resistant and susceptible House Flies.**—*J. econ. Ent.* **46** no. 5 pp. 914–915, 6 refs. Menasha, Wis., 1953.

Egg viability, length of larval life and number of adults obtained from 500 eggs were compared in six normal strains of *Musca domestica* L. and two strains resistant to DDT. No differences between strains were noted that were attributable to resistance [*cf. R.A.E.*, B **42** 74]. Adults from batches reared under crowded conditions were smaller and somewhat weaker than those from batches reared normally, but the smaller flies from a resistant colony reared under crowded conditions, though somewhat less resistant than flies of the same strain reared normally, were far more resistant than flies from a susceptible strain reared under standard conditions.

Button (J. A.). **The Insect Vector in Relation to Myxomatosis in Australia.** —*J. Dep. Agric. W. Aust.* (3) **1** no. 6 pp. 819–821, 823, 825, 827–829, 1 fig., 7 refs. Perth, W.A., 1952.

Early work on the establishment of myxomatosis for the control of rabbits [*Oryctolagus cuniculus*] in eastern Australia [*R.A.E.*, B **33** 117–118] did not indicate that it would be of great value, but a survey begun in 1950 showed that the disease had become widely established in river valleys in New South Wales and the Murray Valley in Victoria and South Australia and spread well along the main watercourses and in the larger irrigation districts [*cf.* also **40** 193]. It was evident that the virus was spread by insects, particularly mosquitos; the chief vectors appeared to be various species of *Aëdes*, *Culex annulirostris* Skuse and *Anopheles annulipes* Wlk. The stickfast flea, *Echidnophaga myrmecobii* Roths., can also transmit the virus [**33** 117], and a species of *Simulium* was seen feeding on the ears of rabbits on the banks of the Murray and would appear to be a potential vector.

The virus was first received in Western Australia in March 1951 and infection centres were established in and after August 1951 in various localities where conditions were thought to be favourable. An account is given of a survey of these areas begun in March 1952. Different degrees of success were obtained from place to place. The results in some were most encouraging, but in others, where conditions were apparently favourable for spread, the disease was maintained only in a smouldering condition. The reason for this is not clear, but the effects of the disease may have been partly obscured by rapid reinfestation by migrating rabbits. The need for the co-operation of every farmer in the district was evident.

Blood-sucking insects found on rabbits in 15 of the myxomatosis centres between September 1951 and August 1952, included four species of *Aëdes*, one or more of which was found in 12 centres, *Culex pipiens fatigans* Wied. in six centres, *C. annulirostris* in two, *Anopheles annulipes* in five, and *E. myrmecobii* and *E. gallinacea* (Westw.), each in four. Haematopinid lice, probably *Haemodipsus ventricosus* (Denny), which transmits the disease in the laboratory, were recovered from rabbits at two of the centres. Evidence of transmission by *E. gallinacea* was provided by experience in an area in which it was abundant on the rabbits, *E. myrmecobii* was not found and mosquitos were scarce. The population of rabbits was dense, and it was estimated that at least 98 per cent. of them were killed by the disease, but the latter did not spread outside a rabbit fence within which it was introduced until the rabbit gates were opened. Of the methods adopted to initiate outbreaks in this and two other areas, in one of which mosquitos were more abundant, the best appeared to be to release numbers of infected rabbits along the course of the selected stream; it proved successful after repeated failures to obtain spread from caged infected rabbits.

Seddon (H. R.). **Diseases of domestic Animals in Australia. Part 3. Tick and Mite Infestations.**—*Serv. Publ.* (*Div. vet. Hyg.*) *Dep. Hlth Aust.* no. 7, 200 pp., 9 figs., 5 graphs, 21 maps (5 fldg.), refs. Canberra, 1952. **Part 4. Protozoan and viral Diseases.**—*Op. cit.* no. 8, 214 pp., 1 graph, 4 maps (3 fldg.), refs. 1952. **Part 5. Volumes I–II. Bacterial Diseases.**—*Op. cit.* no. 9, pp. 1–232, i–viii, 2 figs., 1 graph, 7 maps (1 fldg.), refs.; no. 10 pp. i–vi, 233–464, 2 figs., 4 maps (2 fldg.), refs. 1953.

In the first of these publications, which is the third part of a series [*cf. R.A.E.*, B **40** 72], the ticks and mites that are injurious to domestic

animals and poultry in Australia are reviewed; notes are given on such points as their distribution and abundance, their bionomics as observed in Australia, the effects they produce on the host or the diseases they carry, and the control measures generally used against them, if any. Brief notes are also given on *Linguatula serrata* Fröl. (the nymphs of which are present and not uncommon in cattle in all States, though the only records of adults are in dogs in New South Wales, dogs and foxes in Victoria, and a dingo in South Australia) and on other animals (vertebrate and invertebrate) that are harmful to stock. The latter include a few insects, chiefly species that sometimes cause the death of animals that eat them; the only one that is stated to present a serious problem and is discussed at any length is the sawfly, *Platypsectra interrupta* (Klug), the larvae of which poison cattle in one part of Queensland [*cf.* **26** 149, etc.].

More than half the publication is devoted to an account of the introduction (probably in 1872) and spread of the cattle tick, *Boophilus annulatus microplus* (Can.) (*B. a. australis* (Fuller)), which is established in the north of Western Australia and the Northern Territory, in the north and east of Queensland and in the north-eastern tip of New South Wales, and the measures that have been taken to control it in various States and to eradicate it from New South Wales [*cf.* **16** 193]. Owing to the presence of an arsenic-resistant strain in Queensland, where dipping is carried out privately, DDT is preferred to arsenic there [**36** 103–105]. Various other toxicants have also been tried [**41** 180–181, 195]. Their effectiveness and their effect on stock are reviewed. In New South Wales, where dipping is compulsory and carried out by the government, arsenic-resistance is unknown and dips containing arsenic are used because they ensure success, are simple to prepare and are easier to analyse and much less costly than DDT dips.

Regulations made from 1896 onwards with a view to preventing the southward spread of the tick are reviewed in detail. Entry of cattle from infested areas of Queensland into New South Wales was prohibited at first but was allowed after dipping in certain circumstances from 1902. Infestation subsequently spread into New South Wales, and parts of the State were quarantined. The main provisions now operating regarding border crossings from Queensland are given. Measures of control within New South Wales are discussed by periods (1906–1919, 1920–1926 and 1927 onwards) with details of measures taken and changes in quarantine areas. Attempts to control individual introductions and extensions met with varied success, but it was not until 1932 that an adequate eradication programme with dipping of all stock (cattle, horses and sheep) in an infested area every 14 days for ten months was put into operation. Since that time, 5,370 of the 9,945 sq. miles at one time quarantined have been released. Some changes in the duration of the treatment period have been made where ten months was found to be inadequate. Some areas in which frequent mustering was impracticable were cleared by removing stock until all ticks on the land had died of starvation.

The two remaining parts deal with protozoan and virus diseases and with bacterial diseases of domestic animals and poultry in Australia. The vectors of most of those that are Arthropod-borne are briefly discussed. Among the protozoan diseases, most attention is given to piroplasmosis and anaplasmosis, which occur only in cattle in Australia, where they are caused by *Piroplasma* (*Babesia*) *bigeminum*, *P.* (*B.*) *argentinum* and *Anaplasma marginale* and are transmitted by *Boophilus annulatus microplus*. Antibodies of Murray Valley encephalitis [**42** 15] have recently been detected in horses in Victoria, New South Wales and central Queensland and in dogs, as well as in fowls.

Hitchcock (L. F.). **Resistance of Cattle Tick (*Boophilus microplus* (Canestrini)) to Benzene Hexachloride.**—*Aust. J. agric. Res.* **4** no. 3 pp. 360–364, 6 refs. Melbourne, 1953.

After BHC had been used intensively for about two years at the recommended strength of 500 parts γ isomer per million (0·05 per cent.) against *Boophilus annulatus microplus* (Can.) on cattle in central and northern Queensland [*R.A.E.*, B **41** 195], it ceased to give satisfactory control in many localities. Laboratory tests were therefore made to compare the toxicity of BHC to ticks of two strains of which one (Rockhampton) had been reared for several generations from females that had survived on cattle sprayed with BHC at the recommended strength and the other was normally susceptible. It was estimated from the results that the concentrations of γ BHC required to prevent 50 per cent. of the engorged females of the two strains from laying viable eggs are 7,400 and 40 p.p.m. and those required for 50 per cent. kill of the unattached larvae are 22 and 0·12 p.p.m. It was evident that the Rockhampton strain was highly resistant, the females being more so than those of the BHC-resistant strains of *B. decoloratus* (Koch) in South Africa [**40** 108], but the experiment showed that 500 p.p.m. γ BHC was sufficient to kill 100 per cent. of the larvae, and spraying tests showed that this concentration gives adequate control of larvae and nymphs and of adults that have recently moulted. Control with the recommended concentration should therefore be possible if the intervals between treatments do not allow development beyond the stage of the newly moulted adult.

The Rockhampton strain originated from an area formerly infested by arsenic-resistant ticks but where no chlorinated acaricide other than BHC had been used. It was, however, more resistant than the normal strain to all acaricides tested against it. These (with their concentrations in parts per million) were toxaphene (125), dieldrin (500), chlordane (4,000), p,p'DDT (20,000) and sodium arsenite (400 expressed as As_2O_3), and the percentages of engorged females of the Rockhampton and (in brackets) normal strain that did not lay viable eggs after treatment with them were, respectively, 2 (88), 8 (85), 32 (96), 32 (72) and 4 (25).

Shanahan (G. J.) & Wright (P.). **Swim Dipping Experiments with Arsenic and BHC against the Sheep Body Louse.**—*Agric. Gaz. N.S.W.* **64** pt. 11 pp. 578, 611–614, 4 refs. Sydney, 1953.

Data are given on three experiments in New South Wales in which *Damalinia ovis* (Schrank) was eliminated from sheep by a single swim dipping treatment on a large scale under practical conditions with dips containing 0·00625 per cent. γ BHC or 0·175 or 0·14 per cent. arsenic expressed as As_2O_3. Experimental marked sheep dipped at the end of the treatment remained free from lice for 36, 51 and 33 days, respectively, after which no further observations were made. Untreated sheep remained infested. The first two experiments involved the treatment of 820 and 644 sheep in vats containing 1,000 and 880 gals. dip in October 1951, and the weather became very hot and unfavourable to the louse, so that its numbers on untreated sheep fell. The positive results obtained in these tests may therefore not be truly indicative of the value of BHC or arsenic. The experiment with 0·14 per cent. arsenic, on the other hand, was made in October 1952, when the weather was not so hot, and 9,519 sheep were treated in a vat containing 1,800 gals. (replenished as necessary), so that this experiment provides evidence that arsenical dips can give control under field conditions even when very large numbers of sheep are treated.

Roberts (I. H.) & Rogoff (W. M.). **Organic Insecticides for the Control of Swine Mange.**—*J. Amer. vet. med. Ass.* **123** no. 918 pp. 227–231, 5 refs. Menasha, Wis., 1953.

Reference is made to the results of some earlier experiments on the control of *Sarcoptes suis* Gerl. on pigs with BHC [*R.A.E.*, B **37** 82; **39** 139] or chlordane [**38** 77], and an account is given of tests made in South Dakota between September and June in each of the years 1949–52 on its control on severely infected pigs by spraying once with an organic acaricide. All sprays were wettable-powder suspensions, except those containing di(p-chlorophenoxy)methane (Neotran), which were prepared from an emulsion concentrate. In each case, more than enough fluid was applied to wet the pigs thoroughly. The actual amount varied from 1 to over 4 U.S. quarts per animal according to the size of the animals and the pressure under which the spray was applied. In all tests, except one of those in which chlordane gave a high degree of control, the pigs were kept for a time in the pens in which they had been treated so that they could rub against one another while still wet with spray.

In tests involving 378 pigs on three farms, 0·1 per cent. γ BHC as lindane destroyed all the mites and allowed of complete resolution of the lesions in 55–80 days. In tests involving 489 pigs on five farms, 0·25 per cent. chlordane was completely effective on two farms and gave a high degree of control on two others, but was virtually ineffective on the fifth. Resolution of lesions was complete after 155 and 157 days in the herds in which the mites were eliminated. In tests involving 217 pigs in three small herds, 0·3 per cent. toxaphene failed in each case to eradicate the infestation, but there was considerable resolution of lesions. A spray containing 0·25 per cent. Neotran destroyed most mites in a herd of 50 pigs and caused partial resolution of lesions. A 0·1 per cent. spray of Aramite, a product containing 2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite, failed to provide satisfactory control of mites or healing of lesions in a herd of 175 animals.

Examination of skin scrapings from some of the pigs showed that lindane destroyed the mites within about five hours and chlordane in one test in six hours. It became evident from some of the other tests that a field trial is not conclusive unless post-treatment examinations are continued for three months or longer. The sprays caused no obvious discomfort or injury to any of the pigs involved in the tests, and sprays containing 0·5 per cent. Neotran, Aramite or Ovotran (p-chlorophenyl p-chlorobenzenesulphonate) did not harm a few pigs to which they were applied in a preliminary experiment.

Papers noticed by Title only.

Burr (M.). **The Insect Legion.**—2nd edn., 8¾ × 5½ ins., xvi + 336 pp., 15 pls., 5 figs. London, J. Nisbet & Co. Ltd., 1954. Price £1 1*s*. [*Cf. R.A.E.*, B **27** 178.]

Doss (M. A.) & Humphrey (J. M.). **Index-catalogue of Medical and Veterinary Zoology. Supplement 1. Authors: A to B.**—pp. 1–317. Washington, D. C., U.S. Dep. Agric., 1953. Price $1.00 (from Supt. Documents). [*Cf. R.A.E.*, B **41** 32.]

Gerberich (J. B.). **The Housefly** (*Musca domestica* **Linn.), as a Vector of** *Salmonella pullorum* **(Retteger) Bergy, the Agent of White Diarrhea of Chickens.**—*Ohio J. Sci.* **52** no. 5 pp. 287–290, 8 refs. Columbus, Ohio, 1952.

As fowls habitually catch and eat flying insects and as larvae of *Musca domestica* L. breed in poultry faeces, it appeared that if the agent of a poultry disease was ingested by the larvae and could survive their metamorphosis, fowls might acquire it by eating the flies. The range of spread of the disease would then be directly related to the flight range of the fly. The problem was investigated by experiments with *Salmonella pullorum*, the agent of white diarrhoea, which is widespread in the United States and causes mortality in chicks, diminished egg production, decreased viability of eggs and occasionally death of hens. All pupae used for the tests were sterilised externally to free them from bacterial contamination and were not used until the effectiveness of the sterilisation had been ascertained, and any flies that disseminated bacteria were thus treated if they were to be used again.

Several hundred newly-hatched larvae in groups of 15–20 were put on a pure culture of *S. pullorum* growing on nutrient agar, and maintained at 37°C. [98·6°F.] until they pupated. The tests were made with 301 flies and 64 pupae that died: 31 of the latter were found to contain *Salmonella*. Of the flies, 122 disseminated it on sterile agar, and it was isolated from 28 of the other 179, which were sterilised externally before isolation was attempted. Further tests were made with 67 of the flies that had disseminated the bacteria; 30 of these were given successive opportunities to disseminate it again until they died and were then tested for its presence. It was disseminated by 26 of these flies for periods of 2–15 days, but only one disseminated it for more than nine days. It was not subsequently isolated from this fly, but was isolated after 22 and 20 days from the only other two flies that lived as long as this. The 37 flies not used in this test were fed to 31 healthy chicks, and all of these became infected in ten days or less to a degree that resulted in the occurrence of *Salmonella* in the faeces for a period of three consecutive days, after which they were discarded.

Fukuzumi (S.) & Obata (Y.). **On five new Species of Trombiculid Mites (Acarina) recovered in Miyake-jima Island.**—*Kitasato Arch. exp. Med.* **26** no. 1 pp. 1–22, 5 figs. Tokyo, 1953.

Descriptions are given of the larvae of *Trombicula* (*Leptotrombidium*) *kawamurai*, sp. n., which belongs to the group of *T. akamushi* (Brumpt), and of four new Trombiculids of other genera from Miyake-jima, Japan. The larvae of *T. kawamurai*, of which there were 41, were all taken from two examples of the local subspecies of *Rattus rattus*, one caught in January 1951 in a forest area in the south of the island and the other in January 1952 in a dwelling in the northern part of the island where a case of tsutsugamushi disease was found. The first of these rats was also infested by two of the other new Trombiculids and by *Trombicula scutellaris* Nagayo et al., *T. pallida* Nagayo et al., *T. fuji* Kuwata et al. and *T. kitasatoi* Fukuzumi & Obata [*cf. R.A.E.*, B **42** 50].

Buxton (P. A.). **Symposium on Insecticides. I. The Place of Insecticides in tropical Medicine: an Introduction.**—*Trans. R. Soc. trop. Med. Hyg.* **46** no. 3 pp. 216–226, 59 refs. London, 1952.

(1585) Wt. P17/3897 7/54 E.P. Ltd. Gp. 566. [B] A

Macdonald (G.). **II. The Objectives of residual Insecticide Campaigns.**—*T. c.* pp. 227–234, 1 fig., 11 refs.

Hadaway (A. B.) & Barlow (F.). **III. Some physical Factors affecting the Efficiency of Insecticides.**—*T. c.* pp. 236–242, 35 refs.

Busvine (J. R.). **IV. The newer Insecticides in Relation to Pests of medical Importance.**—*T. c.* pp. 245–252, 51 refs.

Harrison (C. M.). **V. The Resistance of Insects to Insecticides.**—*T. c.* pp. 255–261, 30 refs.

Barnes (J. M.). **VI. The Action of some synthetic Insecticides on Mammals.**—*T. c.* pp. 264–269, 30 refs.

Thomson (R. C. Muirhead-), Gordon (R. M.) & Davey (T. H.). **VII. A Plea for the Standardization of experimental Work on residual Insecticides.**—*T. c.* pp. 271–273.

In the first of these papers, Buxton draws attention to the most important monographs, reviews and summaries that have been published on synthetic insecticides and summarises very briefly from selected literature some of the results obtained with modern insecticides against Arthropods of medical importance.

Macdonald uses malaria as an example to illustrate the numerical relationships between some factors concerned in the transmission of insect-borne diseases and examines mathematically the reduction that must be effected in the adult population of an Anopheline vector to terminate malaria transmission. If the malaria reproduction rate (the size of one generation of infective cases in relation to the size of the preceding one) is above unity, cases will multiply until restrained by various curbs, but if it is below unity, each succeeding generation will be smaller than the last until the disease has been eliminated. The reproduction rate of malaria is $dmaxya$, where d is the mean duration of infectivity of a case in days, m is the mosquito density relative to man, a is the probability that a mosquito will bite man in one day, x is the probability of a mosquito surviving for the period of the extrinsic cycle, and y is the expectation of life of those that do. The function of insecticidal work is to reduce x and y. The equation is represented graphically in a nomogram from which the minimum effective mortality can be ascertained. This may be 32·5 per cent. in the case of a vector that bites man frequently and 15 per cent. in the case of one that does not. Factors to be considered when vector elimination is the objective are also discussed.

Hadaway & Barlow review literature on the physical factors affecting the availability of larvicides to aquatic larvae and of insecticides applied as aerosols and contact sprays and as deposits from solutions, emulsions and wettable powders to insects of medical importance.

In Busvine's contribution, the relative insecticidal potencies to various pests of DDT, DDD, methoxy-DDT (methoxychlor), toxaphene, BHC, chlordane, aldrin, dieldrin, parathion and allethrin, calculated from published data, are shown in a table. Dieldrin is seen to be more effective than DDT against all the species for which data for it are given, and BHC more effective except against mosquito larvae. Chlordane, aldrin and parathion were also more effective against *Musca domestica* L. and the others less so. The acute toxicity to rats of all these insecticides (except allethrin) and of piperonyl butoxide, estimated from various sources, are shown in another table. Parathion is the most toxic (with a median lethal oral dose in mg. per kg. of 3·5–10), followed by aldrin (45), dieldrin (50–55), toxaphene (60–280), BHC (125–225), chlordane (200–500), DDT (150–800), DDD (2,500),

methoxy-DDT (> 6,000) and piperonyl butoxide (> 7,500). The values of the main groups into which the substances fall are then discussed.

Harrison gives a brief outline of knowledge on resistance to DDT in strains of *M. domestica*, *Pediculus humanus humanus* L. (*P. h. corporis* Deg.) and mosquitos and to other insecticides in *M. domestica*, and mentions a record of DDT-resistance in *Cimex lectularius* L. in Hawaii.

Barnes reviews the effect of DDT, BHC, chlordane, aldrin and dieldrin on mammals. All act as convulsive poisons and also produce visible changes in the liver and sometimes other tissues. Microscopically visible lesions are not produced in the brain, though it is the action on the nervous system that kills. It is concluded that more use should be made of biochemical techniques in research into toxicity.

In the concluding paper, attention is drawn to the discrepancies in the results of experiments on the effectiveness of insecticidal deposits against the same species of insect under apparently similar conditions, and such discrepancies are deemed to be unavoidable in field work, because of the many variables involved. A list of 31 factors that have been found to influence results is given. It is suggested that attention should first be concentrated on making laboratory tests of the effectiveness of one or two insecticides under strictly controlled conditions, with the number of variables in each investigation reduced to a minimum. When these basic experiments have yielded sufficiently consistent results to be regarded as reliable, they should be repeated under more natural, but still strictly controlled, conditions, and finally tests should be made under field conditions.

Shute (P. G.) & Maryon (M.). **A Study of human Malaria Oocysts as an Aid to Species Diagnosis.**—*Trans. R. Soc. trop. Med. Hyg.* **46** no. 3 pp. 275–292, 10 figs., 3 refs. London, 1952.

The following is based on the authors' summary. It is suggested that malaria surveys would yield fuller and more accurate information if oöcyst rates were taken into consideration as well as sporozoite rates. Repeated experiments by the authors with the four species of human plasmodia have shown that the minimum time needed for completion of the cycle in the mosquito is shortest in *Plasmodium vivax*, a day or two longer in *P. falciparum* and considerably longer in *P. malariae* and *P. ovale*. Any lowering of the temperature, even for a few hours during each 24-hour period, retards the growth of oöcysts and may delay the completion of the cycle by several days. The authors consider that the oöcysts of the four species can be identified with some certainty, at least until dividing nuclei obscure most of the pigment, and give measurements, descriptions and illustrations of day-to-day changes in them when developing in females of *Anopheles maculipennis atroparvus* van Thiel kept at constant temperature and humidity. The number of grains and the colour of pigment, its arrangement and degree of coarseness are of value in diagnosis. In oöcysts of some species of avian plasmodia, particularly *P. gallinaceum*, the pigment is very coarse. The pigment in *P. vivax* is indistinguishable in colour, number of grains and arrangement from that in *P. cynomolgi*. Some drugs, though not gametocytocidal, may disarrange or even displace the pigment of gametocytes. In a young oöcyst, the number of grains of pigment, its colour and its arrangement in the cyst, resemble closely the pigment as it is seen in the female gametocyte in an erythrocyte. It is therefore suggested that unstained, or very lightly stained, gametocytes of most species of human plasmodia will help in species diagnosis.

Manson-Bahr (Sir P.) & Muggleton (W. J.). **Further Research on Filariasis in Fiji. (A Study of Host-Parasite Relationships, with special Reference to the Status of the Pacific Filaria** *Wuchereria pacifica.*)—*Trans. R. Soc. trop. Med. Hyg.* **46** no. 3 pp. 301–326, 15 figs., 3 graphs, 1 map, 2 pp. refs.

Research undertaken by the senior author in Fiji in 1910 and 1911 indicated that the non-periodic filaria there [*cf. R.A.E.*, B **39** 70] might be differentiated from the typical *Wuchereria bancrofti* showing nocturnal periodicity as a distinct variety or even species, although no morphological difference was found in either the microfilaria or the adult. He proposed the name *W. pacifica* for it in 1941 (*Trop. Dis. Bull.* **38** 361). In 1950, he spent four months in Fiji and resumed his work. In this paper, literature on the periodicity and transmission of filariasis in the Pacific area is reviewed, and further evidence is given in support of the theory that *W. pacifica* is distinct from *W. bancrofti*. Morphological aspects of the problem are discussed in an Addendum by J. J. C. Buckley (pp. 321–324, 13 figs.). Significant differences in length between adults of the periodic type from various parts of the world and non-periodic ones from Fiji were found in both sexes, the Fijian adults being the shorter. It is not certain that the latter were fully grown, but they comprised six females from five different persons and six males from four so that it is unlikely that all were undersized. Other very slight differences were seen.

Observations on a group of Ocean Islanders who had harboured nocturnal *W. bancrofti*, usually without symptoms, and were transferred to Rambi Island, Fiji, in December 1945, showed that they were still fairly heavily infected with filariasis with a relatively nocturnal periodicity in 1950. Thus, a small focus of nocturnal periodicity has been maintained in the heart of an area where filariasis is normally non-periodic. Mosquitos closely related to *Aëdes scutellaris* (Wlk.), which are the vectors of the non-periodic form [*R.A.E.*, B **34** 37; **41** 161], are not known on Ocean Island, but *Culex pipiens fatigans* Wied., the optimum host of the nocturnal form, and *A. aegypti* (L.) breed there in large numbers. There appears to have been no spread of the filariasis on Rambi, though *C. p. fatigans* abounds there, and no infection was found in females of *C. p. fatigans* or *A. vexans* (Mg.) caught in native houses at night, though the filaria developed normally in *C. p. fatigans* derived from the stock culture in Suva. In contrast, a group of Ellice Islanders on an island seven miles from Rambi to which they had been taken two years previously were found to be infected with non-periodic microfilariae, and there were many cases of elephantiasis; a mosquito believed to be *A. polynesiensis* Marks [**41** 161] was abundant.

Three members of the *scutellaris* group, *A. pseudoscutellaris* (Theo.), *A. polynesiensis* and *A. horrescens* Edw., occur in Fiji. *A. horrescens* is a forest mosquito widely distributed in Viti Levu. The female is indistinguishable from that of the more domestic *A. pseudoscutellaris*, but the larvae are very distinct. Colonies were twice reared from individually selected larvae. The reared females of *A. horrescens* fed reluctantly on human blood, and of 15 fed on blood infected with non-periodic microfilariae, only two survived to the fourth day when larvae with development arrested at the sausage (second) stage were seen in them. It appears therefore that *A. horrescens* is not a suitable host for the local non-periodic filaria.

Contact with extract from the thoracic muscles of *C. p. fatigans*, *Anopheles maculipennis atroparvus* van Thiel and *Aëdes pseudoscutellaris* provoked active contortions followed by death in microfilariae of the non-periodic type, but *C. p. fatigans* appeared less lethal than the other two.

Observations are described on the development of the non-periodic Fijian microfilariae in various mosquitos, and it is concluded that *A. pseudoscutellaris* and *A. polynesiensis* are both optimum hosts for them. On the other hand, there was no development beyond the first stage in *A. albopictus* (Skuse) reared from eggs from Hawaii, experiments with *A. vexans* were negative, development beyond the second stage was unusual in *A. aegypti*, though it occurred on occasion, and development in *C. p. fatigans* also was nearly always arrested at the second stage. Chitinisation of non-periodic microfilariae was observed in the optimum host. This occurs also with the periodic form. It is concluded that it is not connected with the agent producing arrested development and death.

J. Kerrest reported in a personal communication in 1951 that filariasis in New Caledonia, which lies between 160 and 170°E. longitude [*cf.* **38** 146], is widespread and is mostly of the non-periodic type, though several other workers have reported nocturnal periodicity there. Clinical manifestations were rare.

Thomson (R. C. Muirhead-) & Mercier (E. C.). **Factors in Malaria Transmission by *Anopheles albimanus* in Jamaica. Part I.**—*Ann. trop. Med. Parasit.* **46** no. 2 pp. 103–116, 7 refs. Liverpool, 1952.

An account is given of an investigation made between January 1950 and April 1951 on the habits of *Anopheles albimanus* Wied. in relation to the part it plays in the transmission of malaria in Jamaica [*cf. R.A.E.*, B **18** 50; **19** 213; **40** 104], where it is the most abundant man-biting Anopheline. Most of the work was carried out near Kingston on the south coast. Under experimental conditions, gland infections were readily produced in females of *A. albimanus* by feeding them on carriers of gametocytes of *Plasmodium falciparum*. They developed in a minimum of nine days in the summer season (May–October), when the mean minimum and maximum laboratory temperatures were 77 and 90°F., and 16 days in the winter season (between mid-December and mid-March), when the mean minimum and maximum laboratory temperatures were 64 and 84°F. The minimum infective density of gametocytes varied considerably among carriers. One man with an unusually high density, sometimes reaching 116 gametocytes per 1,000 leucocytes, did not infect the mosquitos fed on him at intervals over three weeks, but some children of three years old or less, often with few symptoms, could produce a high proportion of gland infections in mosquitos fed when only one crescent could be found in 150 or 200 fields of a thick film. Slides from such subjects might be dismissed as negative, although enough gametocytes were present to infect mosquitos. The lowest threshold recorded was 0·12 gametocytes per 1,000 leucocytes, or about two gametocytes per blood-meal. In such cases, the mosquitos probably ingest more gametocytes than is indicated by the density in the blood-film.

Observations on biting habits of *A. albimanus* showed that there were two sharp biting-peaks, one at sunset and one at dawn, and an almost complete cessation of feeding during hours of darkness. In the dry season (December–July), feeding on man took place almost exclusively out of doors, and in a controlled experiment 898 females were caught at the sunset peak on four summer nights feeding on a donkey tethered out of doors and only 17 in a donkey-baited trap-hut. Only 30 more blood-fed females were taken on the walls and in window traps in the hut on the following mornings. In the rainy season (August–November), however, large numbers were taken in the window traps, whereas there was no corresponding rise in the number feeding out of doors; and many entered

dwellings to feed and those that could not do so immediately because the people were moving about often settled on inner walls. About 10 per cent. of those that entered remained resting indoors during the day. Feeding on man and the large domestic animals, such as donkeys, mules and cows, appeared to be indiscriminate. School children and adults (particularly adult males) were bitten much more readily than young children and infants, and biting was followed by feeding much more readily in the older age-groups than in babies. Intensive searching failed to locate the outdoor resting-places of *A. albimanus*. The indications are that the mosquitos rest impartially on a wide range of vegetation.

HADDOW (A. J.). **A Review of the Results of Yellow Fever Protection-tests on the Sera of Primates from Kenya.**—*Ann. trop. Med. Parasit.* **46** no. 2 pp. 135–143, 1 map, 12 refs. Liverpool, 1952.

The following is virtually the author's summary. The evidence given suggests that bush-babies (*Galago* spp.), and not monkeys, may be the main mammalian hosts of yellow-fever virus in Kenya and the driest parts of Uganda. In such areas, it seems unlikely that mosquitos can be the arthropod vectors responsible for the maintenance of the animal disease. The importance of including series of bush-babies in surveys of such areas is stressed.

HOPKINS (C. A.). **Notes on the Biology of certain *Culicoides* studied in the British Cameroons, West Africa, together with Observations on their possible Rôle as Vectors of *Acanthocheilonema perstans*.**—*Ann. trop. Med. Parasit.* **46** no. 2 pp. 165–172, 1 pl., 12 refs. Liverpool, 1952.

An investigation was carried out in the Kumba area of the British Cameroons, where *Acanthocheilonema perstans* is hyperendemic [*R.A.E.*, B **16** 155], to discover which species of *Culicoides* attack man there and where they breed. Its ultimate object was to ascertain whether or not any species is a vector of *A. perstans* [*cf.* **41** 98–99]; discovery of breeding places would make it possible to obtain uninfected midges in which the development of any microfilariae taken up from man could be followed. It was found that 98 per cent. of the midges biting man by day near villages were *C. grahami* Aust., but *C. inornatipennis* C., I. & M. was the more common away from the villages. The relative abundance of the two species probably depends on the availability of suitable breeding sites. Neither was taken at night. Most of the night-biting midges near villages were *C. austeni* C., I. & M., but an unidentified positively phototactic night-biting species was very common at one place. Only single individuals of other species were taken, and they are unlikely to be of any importance as vectors of parasites of man. Contrary to previous statements [*cf.* **16** 155], *C. austeni* was found to bite in moonlight. It showed a marked preference for dark skin, but *C. grahami* had no apparent colour preference.

Culicoides larvae were found in over half of more than 300 sites examined with a view to locating the breeding places of the man-biting species. The breeding sites of nine species that do not bite man are briefly described; they included moist soil microhabitats of various kinds, rubbish heaps and rot-holes. *C. austeni* and *C. grahami* were found to breed in decaying stems of banana and plantain, which are closely associated with dwellings. Three stages in the process of decay are defined. Larvae of both species were found in stems in the first stage of decay. These may be upright or

prostrate and have rings of fibrous tissue separated by the softer decaying intermediary cells. A few larvae of *C. austeni* occurred in stems in the second stage of decay when a basal disk remains that is hard on the outside and contains a mass of rotting cells. *C. inornatipennis* was represented among adults reared from larvae from rot-holes and third-stage rotting plantain.

Developing filarial larvae were not found in 1,500 females of *C. grahami* dissected, but were found in three out of 70 of *C. austeni* taken near a village. If it should be proved that the night-biting *C. austeni* is a vector of *A. perstans* and be confirmed that it breeds only in stems of banana and plantain and has a short flight range, Europeans are unlikely to be exposed to much risk of infection through it as there are few banana or plantain trees near houses in most European stations. Should the same points be established with regard to the day-biting *C. grahami*, however, the risk would be greater as Europeans often work where it is common.

Groot (H.). **Further Observations on *Trypanosoma ariarii* of Colombia, South America.**—*Amer. J. trop. Med. Hyg.* **1** no. 4 pp. 585–592, 8 refs. Baltimore, Md., 1952.

The name *Trypanosoma ariarii* was proposed in 1951 for a protozoan parasite occurring in man in Colombia; it is apparently related to the human trypanosomes that have been considered to be *T. rangeli* [*cf. R.A.E.*, B **35** 124, etc.], but data regarding the latter do not allow of a complete comparison with it. It was subsequently found in *Rhodnius prolixus* Stål in nature, and as the flagellates were seen in the head as well as in the intestinal tract its distribution was studied in naturally and experimentally infected examples of this bug. Earlier records of success and failure in attempts to demonstrate the presence of *T. cruzi* and trypanosomes classified as *T. rangeli* in the haemolymph and salivary glands of Triatomine bugs are reviewed. Their conflicting nature may be due to lack of information on the duration of infection in the bug, the temperature at which the bugs were kept, the date of the infective meal, the state of fasting, and the number of observations made.

Two series of trials were made with bugs caught in nature in a peasant hut in Nilo, Colombia, where a human case of infection with *T. ariarii* had been found earlier, and a third series was made with experimentally infected bugs. Trypanosomes in various developmental stages were found fairly constantly in the haemolymph and the salivary glands of both naturally and experimentally infected bugs of both sexes. They required several days to reach the haemolymph in some of the adults whether these were naturally infected or infected experimentally as nymphs in the first or last instar, but were also found in the haemolymph of nymphs infected six months before. They were free in the fluid and sometimes within the protoplasm of cells. Flagellates invaded the glands a few days after infection was first found in the haemolymph. Infection of the glands was never found in the absence of infection of the haemolymph. It increased in intensity with the duration of infection of the haemolymph.

One experimentally infected nymph and 11 naturally or experimentally infected adults were used in experiments on transmission of *T. ariarii* to rats by biting under conditions that precluded faecal contamination. Transmission was never effected within six days of the first recovery of *T. ariarii* in the haemolymph but was always effected when more than ten days had elapsed. The eight bugs that transmitted the infection comprised the nymph, three experimentally infected adult females and two males and two females that had been found infected in nature. The nymph and one

of the females each infected two different rats, at intervals of 16 and 23 days. The time elapsing between the bite and the first appearance of *T. ariarii* in the blood of six rats varied from 10 to 48 hours.

These data seem to indicate a cyclical development of *T. ariarii* in *R. prolixus*, in which the flagellates are first present in the intestine after the infective meal, and some of them then migrate to the haemolymph and thence to the salivary glands. From the glands, the trypanosomes can be transmitted through the bite. Transmission as a result of contamination with the faeces may, however, also be possible, as trypanosome forms capable of infecting dogs have been found in them.

Renjifo (S.) & de Zulueta (J.). **Five Years' Observations of rural Malaria in eastern Colombia.**—*Amer. J. trop. Med. Hyg.* **1** no. 4 pp. 598–611, 3 figs., 16 refs. Baltimore, Md., 1952.

Malaria is endemic throughout the vast plain that forms the north-eastern part of Colombia, but indices vary greatly. They are highest in the transition country between the Andes and the savannah, where the rich soil yearly attracts many non-immune immigrants and *Anopheles darlingi* Root breeds in shaded man-made ditches and pools. This species has a very limited distribution in the region, but it is sometimes also found in typical savannah country, where it breeds in the shaded parts of natural permanent or semi-permanent lakes. It has proved to be the most effective malaria vector [*cf. R.A.E.*, B **42** 28] among the 28 species of *Anopheles* in the region. Of 794 females collected in houses and dissected in 1946, 14 were infected (ten with oöcysts and ten with sporozoites). Efficiency in transmission seemed to decrease after the end of the rainy season. No infections were found in 208 females of other species from houses. In the rest of the savannah country, where there is a more stable cattle-breeding population and *A. darlingi* is absent, malaria indices are always low, although the savannah Anophelines such as *A. pessôai* Galvão & Lane, *A. peryassui* D. & K. and *A. parvus* (Chagas) [*cf.* **40** 195] are extremely abundant throughout the rainy season (April–November). As the house-haunting Anophelines, including *A. darlingi*, seldom enter urban areas, malaria tends to be rural throughout eastern Colombia.

The effectiveness of DDT spray deposits in controlling *A. darlingi* is reduced by the fact that it does not rest in houses during the day and because, though more closely associated with man than the other species, it is also found in uninhabited areas and feeds normally on wild animals. Control by spraying the insides of dwellings and also the corridor or entrance where people often sit was begun in 1948. Results are given in a table of control campaigns in three villages of which one was treated twice in 1948, 1949 and 1950, and the other two were treated twice in 1948 and once in each of the next two years. The rates of application per sq. metre were 1 gm. technical-grade DDT in 1948 and 1949 and 2 gm. DDT as a wettable powder in 1950. The parasite indices in the village treated six times and in the other two were 14, 17 and 12 before the first treatment and 0, 0 and 2 after the last. In control tests on rough-surfaced walls treated with 2 gm. DDT per sq. metre, wettable-powder and technical-grade DDT gave complete kill of *A. darlingi* for five and two months, respectively.

Stable-trap catches in a treated locality in 1947–48 and 1950–51 showed a considerable change in species composition of the Anopheline population. *A. strodei* Root and *A. argyritarsis* R.-D. disappeared, *A. darlingi*, *A. albitarsis* Lynch Arrib. and *A. oswaldoi* Peryassú became very scarce, and *A. rangeli* Gabaldon, Cova-García & López, which had been much the most abundant species, was reduced by about two-thirds, whereas *A. benarrochi*

Gabaldon, Cova-García & López and *A. triannulatus* Neiva & Pinto increased in numbers, the latter becoming the most plentiful Anopheline. The decrease of *A. darlingi* is attributed at least in part to the treatment of the neighbouring houses with DDT, but the changes observed in the other species make it clear that factors of a more general nature were involved; those that became scarce or disappeared had seldom previously been taken in houses in the area.

JEFFERY (G. M.). **The Infection of Mosquitoes by *Plasmodium vivax* (Chesson Strain) during the early primary Parasitemias.**—*Amer. J. trop. Med. Hyg.* **1** no. 4 pp. 612–617, 3 refs. Baltimore, Md., 1952.

Successive batches of laboratory-reared females of *Anopheles quadrimaculatus* Say were fed daily on 24 patients in the early stages of a mosquito-induced primary infection with *Plasmodium vivax* from shortly after parasites had appeared in the peripheral blood until suppressive treatment was necessary or for as long as was practicable. On the average, parasites appeared in the blood about 12 days after inoculation and mosquitos were first infected four days later and two days before gametocytes could be discovered by normal examination of blood smears. In one case, gametocytes were first demonstrated and mosquitos infected on the same day. Onset of fever usually preceded infection of mosquitos by two days or more, but in four cases it occurred on the same day and once on the following day. Early mosquito infections were usually of a fairly low grade, both as regards percentages of females infected and numbers of oöcysts in them, but all patients infected some mosquitos by the sixth day of demonstrable parasitaemia at the latest.

It is concluded that these early mosquito infections may be of epidemiological importance, in that, even where good therapeutic measures are available, it would be unusual for the naturally acquired infection with *P. vivax* to be terminated or suppressed in indigenous populations of endemic areas before the infected individual became a potential source of mosquito infections.

CORRADETTI (A.). **The Epidemiology and Control of Oriental Sore in Abruzzo, Italy.**—*Amer. J. trop. Med. Hyg.* **1** no. 4 pp. 618–622, 2 figs., 3 refs. Baltimore, Md., 1952.

Annual applications of DDT at 2 gm. per sq. metre to leave a toxic deposit in all houses and stables were made in June–August 1948 and June–July 1949 over an area of about 6 × 12 miles in a district of the Province of Teramo, where 23·7 per cent. of the population showed either active lesions or scars of cutaneous leishmaniasis [*R.A.E.*, B **40** 159–160]. The sandflies present in the region are *Phlebotomus papatasi* (Scop.), *P. perniciosus* Newst. and *P. perfiliewi* Parrot. The last is the most abundant and has been considered to be the vector. The numbers of new cases found per thousand of the population in the treated area and (in brackets) untreated control areas were 7 (34·7) in the spring of 1949, and 1·3 (40·4) in the spring of 1950. With one observed exception, sandflies disappeared from treated buildings after the first spraying, whereas they became more numerous in houses in the untreated zones. After the second treatment, none at all was observed either indoors or outside in the treated area, while they continued to be abundant in the untreated ones.

Calero M. (C.), Núñez (J. M.) & Silva Goytía (R.). **Rocky Mountain Spotted Fever in Panama. Report of two Cases.**—*Amer. J. trop. Med. Hyg.* **1** no. 4 pp. 631–636, 2 graphs, 6 refs. Baltimore, Md., 1952.

Descriptions are given of two cases of Rocky Mountain spotted fever that occurred in Panama in 1951 and bring to four the total number of cases reported on the Isthmus. The nature of the infection was established by the complement-fixation test. The four cases were from widely scattered areas. One of the patients was a woman of advanced age who spent her life in her home in Panama City, and it appeared possible that she might have been infected by ticks brought to the house by a dog. Attempts to isolate rickettsiae from 30 larvae, nymphs and adults of *Rhipicephalus sanguineus* (Latr.) found on this dog three months after the patient had been in hospital were unsuccessful, but the dog had been given a germicidal bath ten weeks earlier and this may have killed any infected ticks present.

Beye (H. K.), Edgar (S. A.), Mille (R.), Kessel (J. F.) & Bambridge (B.). **Preliminary Observations on the Prevalence, clinical Manifestations and Control of Filariasis in the Society Islands.**—*Amer. J. trop. Med. Hyg.* **1** no. 4 pp. 637–661, 3 figs., 31 refs. Baltimore, Md., 1952. (With a Summary in French.)

An account is given of observations carried out for periods of 12–24 months between November 1948 and September 1950 in nine experimental areas on the island of Tahiti and one on Maiao. It is concerned with the epidemiology and extent of filariasis and with a comparison of measures for its control; those selected for test, separately and in combinations of two or three, were treatment of the people with Hetrazan (1-diethylcarbamyl-4-methylpiperazine) and control of mosquitos by sanitation or the use of DDT.

Surveys showed the presence of microfilariae in the capillary blood of 33 per cent. of the people over five years old in the ten areas and of 40 per cent. of the males and 33 per cent. of the females in seven of them. The density of microfilariae was about twice as high in males as in females. It increased with age to a peak in the group 40–49 years old. Clinical filariasis was found in 41 per cent. of persons examined over one year of age. The first attack occurred most often between the ages of 20 and 29 years. Adult filariae were recovered from two people, and both these and the microfilariae resembled *Wuchereria bancrofti* as described from other regions. Animals and birds of various kinds were examined for microfilariae, and some of the dogs and cats were found positive for *Dirofilaria immitis*.

Nine species of mosquito were found on Tahiti and three of them on Maiao. The most common and the only ones consistently numerous as adults in all ten areas were the day-biting *Aëdes polynesiensis* Marks (*pseudoscutellaris*, auct.), which is the principal vector [*cf. R.A.E.*, B **41** 161–162], and the night-biting *Culex pipiens fatigans* Weid. (*C. quinquefasciatus*, auct.). The principal breeding places of mosquitos in Tahiti were pools, swamps, ditches, kitchen drains and the water in tree holes, bamboo stumps, rock holes, fallen leaves, coconut shells and rat-eaten coconuts, and such artificial containers as tins and tyres. In 1949, before control measures were instituted, breeding was widespread in all nine areas, and no subsequent reduction was observed in three areas in which no sanitation or DDT was used. However, after sanitation (clearing coconuts, tins, etc. for a radius of 50–75 yards around each dwelling, emptying or closing tree holes and cutting tall weeds) was enforced in two areas, DDT applied in two others (5 per cent. in emulsified solution to the interior of dwellings and

sheds every three months and 1 per cent. to outside surfaces of buildings and shrubs within 20–30 yards of the houses) and both sanitation and DDT used in a further two, mosquito breeding was found to be confined almost exclusively to rat-eaten coconuts, tree holes and swampy places.

The numbers of mosquitos showed little or no decrease in the areas where no mosquito control measures were applied, but there was generally a decrease in the other areas; it appeared that either DDT or sanitation alone was more effective against *C. p. fatigans* than against *A. polynesiensis*, but all the treatments reduced the percentages of females of the latter that contained infective filarial larvae. These percentages at the close of the experiment in September 1950 and (in brackets) before it began in August 1949 were 0 (5·9) where sanitation was used alone, 2 (6·5) where DDT was used alone and 1 (10) where the whole population of the area was treated with Hetrazan and mosquitos were not controlled, as compared with 9·1 (4·7) where no treatment of any kind was used. The data are insufficient to warrant comparison of the measures used. DDT and sanitation had no effect on microfilarial rates or densities during one year; both were reduced by Hetrazan, but it did not reduce the frequency or severity of clinical filariasis.

It was concluded that a combination of drug treatment, sanitation and the use of insecticides would offer the best prospect of success in the control of filariasis in a highly endemic area, and studies were being continued to determine the most effective method of applying and associating them.

Jachowski jr. (L. A.) & Otto (G. F.). **Filariasis in American Samoa. II. Evidence of Transmission outside of Villages.**—*Amer. J. trop. Med. Hyg.* **1** no. 4 pp. 662–670, 4 figs., 4 refs. Baltimore, Md., 1952.

Filariasis in Samoa is caused by the non-periodic form of *Wuchereria bancrofti* transmitted by *Aëdes polynesiensis* Marks (*pseudoscutellaris*, auct.) [*cf. R.A.E.*, B **41** 161–162]. It has hitherto been believed that the villages are the main source of infection because of the close association of infected mosquitos with them [**34** 39], but transmission on trails outside villages would be expected from the fact that microfilariae are present in the blood by day and that the vector bites by day and for preference in the cooler hours after daybreak and before sunset, which are the times chosen by the natives for activities that take them outside the villages.

The typical Samoan village is almost surrounded by bush, but is situated on the coast or beside a road and has an area (the malae) cleared of undergrowth between the houses and the road or beach. The houses do not have permanent side walls, and some of those in small villages are actually within the bush. Surveys were made in 1948 at four sites in and near ten villages in American Samoa to ascertain for each site the average number of females of the vector that come to attack man in ten minutes (vector density) and the percentage of females containing developing filariae; and these figures were used to estimate an " index of transmission " (number of females containing filariae that attack man in ten minutes). The collection sites were the interior of a house in the village, a point in the malae 25 yards from the nearest houses in the centre of the village, and two points on a bush trail 50–100 and 150–250 yards from the houses. The percentages of females containing filariae in these sites averaged 5·2, 6·9, 2·9 and 4·9, respectively, but the vector densities were 10·8, 3·1, 18·6 and 32·6, so that the indices of transmission were 0·6, 0·2, 0·5 and 1·6. The index for the houses that were not actually within the bush was only 0·1. Thus transmission in the village proper is of little importance,

and the number of mosquitos coming to bite rises rapidly as distance from the village increases. Further random searching revealed no place in jungle or bush that was free of the mosquitos, but infected ones were found only in areas visited by man.

Trembley (H. L.). **The Distribution of certain Liquids in the Esophageal Diverticula and Stomach of Mosquitoes.**—*Amer. J. trop. Med. Hyg.* **1** no. 4 pp. 693–710, 1 fig., 36 refs. Baltimore, Md., 1952.

The following is virtually the author's summary. There is general agreement as to the way in which mosquitos feed, but a divergence of opinion as to whether the distribution of a liquid in the alimentary canal depends on the manner of feeding, the kind of liquid ingested or a combination of both. Experiments were carried out on four species of *Anopheles*, four of *Aëdes* and *Culex pipiens* L. to investigate this subject more thoroughly. The mosquitos were fed on whole blood by allowing them to bite or to imbibe from saturated cellucotton, on glucose solution from cellucotton and through membranes, and on mixtures of whole blood and sugary solutions through membranes. Under all conditions, blood was dispatched primarily to the stomach [*cf. R.A.E.*, B **36** 215], and with few exceptions in smaller amounts to the diverticula. The proportion of mosquitos showing blood in the diverticula appeared to be a distinguishing physiological characteristic of the species and ranged from less than 11 per cent. in *Aëdes albopictus* (Skuse) to over 70 per cent. in *Anopheles quadrimaculatus* Say. Glucose solutions, regardless of species or manner of feeding, were found primarily but not exclusively in the diverticula. When mixtures of blood and honey were given to *Aëdes aegypti* (L.), they went primarily to the stomach, but traces were found occasionally in the diverticula.

Fredeen (F. J. H.), Spinks (J. W. T.), Anderson (J. R.), Arnason (A. P.) & Rempel (J. G.). **Mass Tagging of Black Flies (Diptera: Simuliidae) with Radiophosphorus.**—*Canad. J. Zool.* **31** no. 1 pp. 1–15, 1 pl., 4 graphs, 11 refs. Ottawa, 1953.

The following is almost entirely based on the authors' summary. A method for tagging large numbers of *Simulium* spp. for flight-range investigations, devised in the course of work in Saskatchewan during 1950–51, is described. Radioactive larvae, pupae and adults that were readily detected with a Geiger counter were obtained by keeping the larvae for 24 hours in a very dilute solution of a compound containing radioactive phosphorus (0·2 microcuries per ml.) and then returning them to non-radioactive water to complete their development. The treatment did not visibly harm the larvae or adults. Larvae were treated in the laboratory in small containers of water that was circulated and aerated with air jets, and in the field in galvanised iron tubs placed in the river and filled to a depth of 8 ins. with river water, which was kept in motion by means of a paddle wheel on a shaft driven by a larger paddle wheel dipping into the river. In field tests, tagged larvae and pupae were found as far as 520 yards downstream from the point at which they were returned to the river. Tagged adults were taken in cages placed over radioactive larvae and pupae in the stream, but only one was caught in the open, and this only 100 yards from the stream. Failure to find more tagged adults was believed to be due mainly to inadequate collecting methods.

Khan (Nawab H.). **On the Effectiveness of " Pyrenones " against Tabanids.** —*Indian J. Ent.* **14** pt. 1 pp. 53–59, 6 refs. New Delhi, 1952.

Experiments were carried out in Massachusetts in 1949 and 1950 on the use of sprays containing pyrethrum with piperonyl butoxide or piperonyl cyclonene to protect cattle and horses from Tabanids (mainly three species of *Tabanus*) [*cf. R.A.E.*, B **39** 152; **40** 95]. The two concentrates used (T-143 and T-237) contained 10 gm. piperonyl butoxide and piperonyl cyclonene, respectively, with 1 gm. pyrethrins per 100 ml., and each was used in water at dilutions of 1 : 9, 1 : 14 and 1 : 19. About 2–3 U.S. pints spray were applied per animal. The sprays containing piperonyl butoxide were much superior to those containing piperonyl cyclonene, presumably because of the rapid oxidation of the latter. Protection decreased as dilution increased, and only 1 : 9 gave more than 50 per cent. protection for three days on cattle or two days on horses in favourable weather. Heavy rain removes most of the spray, but is also unfavourable to the flies.

Statens Skadedyrlaboratorium. Årsberetning 1950–1951. [Government Pest Infestation Laboratory (Stored Products and Household Pests). Annual Report 1950–51.]—45 pp., 5 figs. Springforbi, 1953. (With Summaries in English.)

In addition to information noticed elsewhere [*R.A.E.*, A **42** 193], this further report from Denmark [*cf.* B **40** 115] contains the results of continued investigations on house-flies (*Musca domestica* L.) resistant to insecticides. Since resistance to BHC had been observed late in 1949, chlordane was recommended for use as a deposit spray in 1950. BHC was also used, but resistance to it increased in many places, and chlordane was substituted, at first with good results. In July, however, resistance to chlordane was reported from several farms in the island of Lolland where BHC also failed to give control. Four strains of flies from this area were exposed to deposits of various insecticides by the flower-pot method [B **40** 116] and compared with a laboratory DDT-resistant strain. All four strains showed high resistance to BHC, chlordane and dieldrin and also to toxaphene. Exposures to DDT showed that some 10–35 per cent. of the flies of each of the four strains were susceptible and clearly distinct from the rest, which were about as resistant as the laboratory strain. The susceptibility to DDT had probably arisen through mutation or segregation or been introduced into the population during the period of about two years when DDT was not used. Topical application of insecticides in acetone to the mesothorax showed that resistance to DDT, BHC and chlordane was as high in some Danish strains as any recorded under natural conditions in the United States. Multi-resistance was reported from other places later in the year, and it was thought that control in 1951 would have to be based largely on the earlier methods developed by M. Thomsen [*cf.* B **26** 112, etc.].

Exploratory tests indicated that for an equal concentration of γ BHC, lindane was no more effective than crude BHC against BHC-resistant flies, that Dilan (a 2 : 1 mixture of 1,1-bis(p-chlorophenyl)-2-nitrobutane and 1,1-bis(p-chlorophenyl)-2-nitropropane) had little effect on DDT-resistant flies, and that the addition of piperonyl cyclonene did not materially increase the toxicity of DDT to DDT- and multi-resistant flies.

Preliminary experiments in which DDT-resistant strains were crossed with a susceptible strain (strain B) showed that susceptibility to DDT was partly dominant, the F_1 adults being comparatively susceptible, though not quite so susceptible as adults of strain B. Segregation of DDT-resistance

occurred in the F_2 adults and others produced by back crossing F_1 to strain B, but the material was not sufficient for conclusions to be drawn as to the number and mode of action of the genes concerned. A further study of the inheritance of resistance to DDT, BHC and chlordane was begun, but gave inconclusive results.

Norton (R. J.). **Inheritance of DDT Tolerance in the House Fly.**—*Contr. Boyce Thompson Inst.* **17** no. 2 pp. 105–126, 1 graph, 23 refs. Yonkers, N. Y., 1953.

Comparisons were made of the relative degrees of tolerance of the immature stages of house-flies (*Musca domestica* L.) of five strains to DDT and four of its analogues. The strains were the Ellenville and Bellflower DDT-tolerant strains [*R.A.E.*, B **38** 87; **40** 14], Multi strain I from Illinois, which had been reported to show more than 1,000 times the normal tolerance to DDT deposits, a BHC-tolerant strain from New Hampshire [**38** 183] and a non-tolerant laboratory strain. The compounds were aerosol-grade DDT and DDD (TDE) and technical-grade fluoro-DDT (DFDT), methoxy-DDT (methoxychlor) and methyl-DDT (ditolyl trichloroethane). Immersion of eggs of the various strains for 15–30 seconds in 10 per cent. acetone solutions of the toxicants had no effect on hatching. Larvae were treated by confining them on deposits of DDT on filter paper. Fluoro-DDT was the most toxic compound to the larvae of all strains. Average survivals of all strains exposed to it and to DDT were 52 and 65 per cent., with the remaining analogues appearing intermediate in effectiveness and not significantly different from one another. The laboratory strain showed little variation in reaction to the different compounds. Relative tolerance of larvae of the various tolerant strains to the deposits was directly correlated with the tolerance of the adults to vaporised DDT. Emergence from puparia was markedly reduced by immersing them for 15–20 seconds in a 10 per cent. solution of any of the compounds, but all tolerant strains, including the one tolerant to BHC, showed higher percentage emergence than the laboratory strain, and little difference from one another in response to any particular treatment. Fluoro-DDT was more toxic than the other compounds to pupae of all strains, as it was to larvae, but no significant difference was observed between the mean responses of the tolerant strains to treatment with the remaining toxicants. The laboratory strain was far more susceptible to fluoro-DDT than to any other compound. There was no apparent correlation between pupal weight and susceptibility of the emerging adults to the various treatments.

Exposure of adults for four hours to continuously vaporised DDT showed the relative order of tolerance at the LD50 level to be Multi strain I (4·5), Bellflower (3·7), Ellenville (3·3), BHC-tolerant (3) and laboratory (1). After eight months of rearing as inbred cultures, without exposure to any toxicants, all strains showed a marked decline in tolerance except Multi strain I, which still had its original high level of tolerance after an additional six months of similar inbreeding. The possible implications of this are discussed.

In cross-breeding experiments with a tolerant and the laboratory strain, no difference in tolerance to DDT could be detected between progeny of paired crosses and mass crosses. In each cross between a tolerant strain and the laboratory strain, the level of tolerance in the filial generation was about midway between that shown by the parent strains, and it did not vary appreciably during ten ensuing generations. The level of tolerance was consistently higher for ten generations in the progeny of laboratory ×

Multi strain 1 or laboratory × Bellflower than in the progeny of the reciprocal crosses, but it is doubtful whether such a difference indicates sex-linked characteristics. All progeny of crosses between two tolerant strains showed a tolerance to DDT somewhat below the point midway between the levels of tolerance of the parent strains, and the level was maintained through ten successive generations. The secondary tolerance to DDT shown by the BHC-tolerant strain and the primary tolerance to DDT of the remaining strains appeared to be similarly transmitted. When the progeny of crosses between Multi strain I and the laboratory strain were backcrossed to the tolerant parent strain, the level of tolerance in the offspring was progressively increased with each successive backcross and was slightly higher if the tolerant parent was male than if it was female. A nearly symmetrically divergent pattern of tolerance evolved from equivalent backcrosses with the susceptible parent strain, the level of filial tolerance being progressively reduced with each such successive backcross. A lengthened life-cycle, which was associated with tolerance in some strains appeared to be directly attributable to longer larval stages, but it was not of necessity associated with tolerance.

Bow (M. R.) & Brown (J. H.). **Rocky Mountain Spotted Fever in Alberta, 1935–1950.**—*Canad. J. publ. Hlth* **43** pp. 109–115, 3 figs., 29 refs. Toronto, 1952.

Records are given of nine known and four suspected cases of Rocky Mountain spotted fever that occurred in Alberta between 1935 and 1950 [*cf. R.A.E.*, B **32** 10]. All of them had a history of tick bite and were in the southern part of the Province where *Dermacentor andersoni* Stiles is present [**33** 74; **39** 56]. Five of the known cases were fatal, and of these four were contracted in the Manyberries area in the extreme south-east and the fifth further north to the west of Redcliff. Ticks infected with the agent of spotted fever were recovered from the areas where the known cases occurred.

Roulston (W. J.), Hitchcock (L. F.), Turner (A. W.) & Campbell (A. D.). **The Effect on Cattle of long-continued cutaneous Applications of DDT.** —*Aust. J. agric. Res.* **4** no. 4 pp. 469–480, 1 graph, 17 refs. Melbourne, 1953.

The following is virtually the authors' summary. An experiment was carried out near Brisbane and another near Melbourne to determine the hazard of long-continued cutaneous applications of DDT to cattle. In Queensland, steers were treated weekly for three years with 22·5 gm. DDT in groundnut oil, which was rubbed on their backs, and some were autopsied at the end of each year. In Victoria, the experiment was commenced with young cows, and the same amount of DDT in the same or another vegetable oil was applied in the same way. The animals bore up to three calves, which they suckled for 5–6 months, and were autopsied after treatment for 3½ years.

Signs of poisoning were never observed in adults or calves and, except for a brief period during the second year of the Queensland experiment, there was no significant difference between the growth rates of treated and untreated animals. At autopsy, DDT was found in tissues, particularly fatty tissues, in amounts up to 425 parts per million, and lower concentrations were found in similar tissues of untreated animals pastured with those treated. In no case was histological evidence of toxic effects upon tissues

found. Milk samples taken during the first lactation of the cows, after treatment had been in progress for 20 months, contained 3–4 p.p.m. DDT.

Since the intensity of application exceeded that of any treatment that would be made under field conditions, it is concluded that any likely rate of dipping in aqueous suspensions of 0·5 per cent. p,p′ DDT for tick control would be quite harmless to cattle.

Payzin (S.) & Akyay (N.). *Ornithodorus lahorensis* **kenelerinde tabiî olarak** *Coxiella burnetti*'**nin bulunusu.** [Natural Occurrence of *Rickettsia burneti* in the Tick, *O. lahorensis*.]—*Turk. Bull. Hyg. exp. Biol.* **12** no. 1 pp. 8–19, refs. Ankara, 1952. (With a Summary in English, pp. 17–19.)

The authors refer to experiments in Turkey in which *Ornithodoros lahorensis* Neum. became infected with *Rickettsia* (*Coxiella*) *burneti*, the causal agent of Q fever [*cf. R.A.E.*, B **40** 119–120], and state that strains of rickettsiae were isolated from two out of about 50 batches of *O. lahorensis* taken in villages or farms in eastern Turkey in July 1951, suspensions of which were injected into guineapigs. The two strains were identified as *R. burneti* on the basis of serological tests and the fact that they both showed cross-immunity with various American strains of *R. burneti*, but none with *R. prowazekii*.

Carley (J. G.) & Pope (J. H.). **The Isolation of** *Coxiella burneti* **from the Tick** *Ixodes holocyclus* **in Queensland.**—*Aust. J. exp. Biol. med. Sci.* **31** pt. 6 pp. 613–574 [*i.e.* 614], 2 refs. Adelaide, 1953.

During routine examination of ticks from various parts of Queensland for the presence of infective agents, *Rickettsia* (*Coxiella*) *burneti*, the causal agent of Q fever, was isolated from two batches of *Ixodes holocyclus* Neum. The first batch consisted of eight females removed in August 1952 from his cows by a dairy farmer in northern Queensland who had had Q fever in December 1951, and the second of three unattached nymphs collected about 20 miles north-west of Brisbane in September 1952. *I. holocyclus* is the tick that most commonly attacks man in Queensland and has long been known to be able to transmit Q fever experimentally [*R.A.E.*, B **31** 106, 204], but this is the first time that infection has been found in it in nature.

Papers noticed by Title only.

Daviaud (R.). **Étude des méthodes de dosage du D.D.T.** [a comparison of methods of determining DDT, including experimental results].—*Ann. Epiphyt.* **3** no. 4 pp. 511–525, 2 figs., 31 refs. Paris, 1952.

Ryckman (R. E.) & Halstead (B. W.). **Report of a Case of human nasal Myiasis by the Greenbottle Fly,** *Phaenicia* [*Lucilia*] *sericata,* **in San Bernardino County, California.**—*Amer. J. trop. Med. Hyg.* **1** no. 4 pp. 711–712, 3 refs. Baltimore, Md., 1952.

Krastin (N. I.). **The Decipherment of the Cycle of Development of the Nematode** *Thelazia skrjabini* **Erschow, 1928, a Parasite of the Eyes of Cattle.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **82** no. 5 pp. 829–831, 5 refs. Moscow, 1952.

Since previous work by the author in the Soviet Far East suggested that *Musca amica* Zimin was the intermediate host of *Thelazia skrjabini*, one of the three nematodes of that genus that cause inflammation of the eyes of cattle in the Soviet Union [*R.A.E.*, B **40** 70], further investigations were carried out in 1951. Over 17,000 adults of *M. amica* were taken on a farm in the Amur district where infection with *Thelazia* was common, and their heads were dissected in saline. Of 223 infective *Thelazia* larvae obtained from them, most were *T. gulosa*, but several possessed a very small mouth capsule and a body of a more uniform thickness. Two healthy calves were then isolated under conditions protecting them from flies, and 175 of the larvae were introduced into the conjunctival sacs of one of them between 9th July and 6th August. Autopsy on 18th August revealed the presence in the lachrymal ducts of ten examples of *T. gulosa* and one female of *T. skrjabini*, a description of which is given. The control calf remained free from infestation. It is concluded that *M. amica* acts as an intermediate host of both *T. gulosa* and *T. skrjabini*.

It has been shown in the course of the author's study of the biological cycles of *Thelazia* in the Soviet Far East, that the larvae of *T. rhodesi* develop only in the viviparous *M. convexifrons* Thoms. [*cf.* **39** 205] and those of *T. gulosa* [*cf.* **40** 69] and *T. skrjabini* only in the oviparous *M. amica*. *M. amica* and *M. convexifrons* do not occur in the European part of the Soviet Union, where they are replaced by the oviparous *M. autumnalis* Deg. and the viviparous *M. larvipara* Portsch., but Klesov found that *T. rhodesi* develops in both these flies in the Ukraine [**39** 205] and that the viviparous species (*larvipara*) also acts as an intermediate host for *T. gulosa* [**42** 45].

Serdyukova (G. V.). **New Data on the Development of the Larvae and Nymphs of** *Ixodes ricinus* **L. under natural Conditions.** [*In Russian.*] —*Dokl. Akad. Nauk SSSR* (N.S.) **83** no. 5 pp. 769–772, 11 refs. Moscow, 1952.

In further observations on the overwintering of *Ixodes ricinus* (L.) in the Karelian Isthmus [*cf. R.A.E.*, B **42** 70], small cages of metal gauze containing larvae or nymphs were sunk in the forest litter to depths of 4–6 ins. during the summers of 1947–50 and examined periodically until autumn and again in the following spring. The 30 batches of larvae used each hatched in the cage concerned from a single batch of eggs, and the nymphs resulted from engorged larvae that moulted in the cages. The lids were incompletely closed, a slit being left just sufficiently wide to permit the larvae or nymphs to leave the cages in quest of a host. The newly hatched larvae remained in a cluster, usually on the empty egg shells, and apparently passed the winter in a passive state. They began to be active at the end of May and left the cages in search of hosts during the ensuing month. The nymphs remained motionless in the substratum in the cages, but those that were disturbed crawled about and attached themselves to the observer if they could. Those that were left overwintered and abandoned the cages in late May and June. Winter mortality was very low.

Larvae that had hatched in August could seldom be induced to attach themselves to a host in September, but attached themselves firmly when they were taken from under the snow in February or when they had overwintered. Newly moulted nymphs caged on a host in September engorged,

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but their tenacity and ability to seek a host was not ascertained. Female adults that had moulted 20–45 days before, fed when placed on a rabbit in March or June and paired with males on the host or in cages, but in nature the adults always appeared between the end of July and the beginning of September, and hibernated without having fed. Of 485 adults of both sexes, 145 survived the winter.

The observations indicated that the larvae and nymphs, and probably the adults also, normally remain inactive for a period after they have hatched or moulted but are capable of movement and of feeding when placed on a host. Their inactivity is a sign of incomplete physiological development of the sensory organs that enable them to perceive a host and induce them to attach themselves to it. There thus exist two well defined periods in the development of the larvae and nymphs.

Burroughs (A. L.). **Sylvatic Plague Studies. X. Survival of Rodent Fleas in the Laboratory.**—*Parasitology* **43** no. 1–2 pp. 35–48, 33 refs. London, 1953.

The following is mainly taken from the author's summary. A laboratory study was made of the duration of adult life under various ecological conditions of two species of fleas parasitic on domestic rats (*Xenopsylla cheopis* (Roths.) and *Nosopsyllus fasciatus* (Bosc)) and six species parasitic on the wild rodents that form the reservoir of sylvatic plague in California. All the 10,795 fleas used were laboratory reared. They were maintained at different temperatures and humidities within a range encountered in their natural habitats. Different conditions of host availability were simulated by feeding some fleas only once at the beginning of an experiment, others daily and others not at all. Generally, the fleas that were fed once before starvation survived a little longer than those that were not fed at all.

Except for *Opisodasys nesiotus* Augustson, all the species were potentially long-lived under some of the laboratory conditions. In all instances, the fleas that lived longest were those kept at relative humidities of 90 per cent. or more and fed daily. One male of *O. nesiotus* survived for 48 days, the longest period for a member of this species. In all the other species, a female lived longest, and the maximum durations of life were over five months in *X. cheopis*, over six months in *Malaraeus telchinum* (Roths.), over nine months in *N. fasciatus*, 10½ months in *Orchopeas sexdentatus sexdentatus* (Baker), over 11 months in *Diamanus montanus* (Baker), nearly 12 months in *Oropsylla idahoensis* (Baker) and nearly 16 months in *Megabothris abantis* (Roths.).

Willett (K. C.). **The Laboratory Maintenance of** *Glossina*. **I.**—*Parasitology* **43** no. 1–2 pp. 110–130, 7 figs., 9 refs. London, 1953.

The following is based on the author's summary. Experiments were carried out at Shinyanga in Tanganyika in 1951 with the object of devising means of maintaining large numbers of *Glossina* in the laboratory. Most of the work was done with the local species, *G. swynnertoni* Aust., but maintenance of *G. morsitans* Westw., *G. pallidipes* Aust. and *G. austeni* Newst. was also tried. Attempts at maintenance at a constant temperature of 26°C. [78·8°F.] failed completely, chiefly owing to the impossibility of maintaining an adequate humidity with the apparatus used. Maintenance in the laboratory (with higher temperatures and consequently lower relative humidity for most of the 24 hours) gave very poor results with inadequate length of life. Life was prolonged considerably by keeping the

flies in an open-sided thatched hut in cages over water; under these conditions, some batches of ten flies in a cage had a mean life of as much as 110 days even in the most severe part of the dry season. Flies were fed either on guineapigs in a feeding-rack or on sheep in a crush by fixing the cages round the flanks and abdomen with an elastic band. The earlier comparisons of the two methods were inconclusive or favoured feeding on guineapigs, but after prolonged maintenance, feeding of *G. swynnertoni* on sheep gave much the better results. The population fed on sheep increased progressively up to the sixth and seventh laboratory-bred generations. The population fed on guineapigs increased at first but later declined sharply. *G. pallidipes* did much better on sheep from the outset. Fertilisation was achieved easily with *G. swynnertoni* and *G. austeni*, less easily with *G. morsitans*, and only with great difficulty in the case of *G. pallidipes*.

Total weight loss of pupae depended chiefly on humidity and very little, if at all, on temperature. Pupae were finally kept at laboratory temperatures with a constant relative humidity of 90 per cent. In early generations of *G. swynnertoni* and *G. morsitans*, there was significant negative skewness of the distribution curves of initial weights of pupae, indicating an excess of small pupae. Flies emerging from these under-weight pupae were eliminated from the maintained population. The lower limits of initial pupal weight, below which the emerging flies were excluded, were 22 mg. for *G. swynnertoni* and 24 mg. for *G. morsitans*. In general, mean weight of pupae decreased from generation to generation. In the population fed on guineapigs, weights were high in the early generations and later dropped sharply. In the population fed on sheep, weights were rather lower at first but decreased only slightly and then, in the latest generations, increased a little. There was an increase in the total weight-loss of pupae from pupation to emergence in later generations. The mean inter-larval period was consistently longer than the known period for *Glossina* at the temperatures experienced, and indicated a proportion of abortions of as much as 50 per cent. Weight-loss of pupae was proportional to size. Males of *G. swynnertoni* examined lost 1·1–1·6 per cent. more of their initial weight than females. This difference was fully established within the early period of rapid weight-loss and was increased only a little by the greater loss in the males in the last few days before emergence.

Early results with *G. austeni* showed it to live a long time and have a very good reproduction-rate, both exceeding the records for the other species maintained. It is suggested that it may prove to be a valuable laboratory vector of trypanosomes in view of these promising results in a climate very unlike that of its natural habitat.

Heisch (R. B.) & Harvey (A. E. C.). **The Biology of** *Ornithodoros graingeri* **Heisch & Guggisberg, 1952.**—*Parasitology* **43** no. 1–2 pp. 131–132, 2 refs. London, 1953.

Heisch (R. B.). **On a Spirochaete isolated from** *Ornithodoros graingeri*.—*T.c.* pp. 133–135, 1 ref.

In the first paper, laboratory observations are described on the life cycle of *Ornithodoros graingeri* Heisch & Guggisberg, a tick that occurs in large numbers in caves on the Kenya coast, south of Mombasa. The caves have a temperature of 24–27°C. [75·2–80·6°F.] and a relative humidity of 90 per cent. or more. At 28°C. [82·4°F.] and 95 per cent. relative humidity, the average durations (and ranges) of the egg, larval, and first, second, third and fourth nymphal stages were 15 (13–18), 13 (9–28), 15 (10–31), 20 (13–60), 29 (14–93) and 25 (16–56) days, respectively, and the periods

between female emergence and feeding and between mating and oviposition were 3 (1–9) and 9 (7–13) days. Of the 152 ticks reared, 137 became adults after the third nymphal stage and 15 after the fourth. Fertilised females laid 125 (40–174) eggs over a period of 22 (14–46) days. Limited observations at different relative humidities showed that the tick was very sensitive to the changes.

The subject of the second paper is a spirochaete that was isolated from two batches of *O. graingeri* and is named *Spirochaeta graingeri*, sp.n. It did not infect guineapigs, a monkey and a young rabbit, but caused very scanty infections in white rats and mice and a persistent but irregular parasitaemia in a man. The man's temperature was also erratic, but was difficult to correlate with the parasitaemia.

DAVIES (D. M.). **Longevity of Black Flies in Captivity.**—*Canad. J. Zool.* **31** no. 3 pp. 304–312, 7 figs., 12 refs. Ottawa, 1953.

Observations by the author on natural populations of *Simulium venustum* Say in Ontario, including some made in the course of work already noticed [*R.A.E.*, B **41** 209], indicated that the females have a preoviposition period of 2–3 weeks and that most of them die before they have completed it. In view of the importance of maintaining laboratory stocks of Simuliids in connection with work on the transmission of avian blood parasites of the genus *Leucocytozoon* [*cf.* **40** 73], their survival under laboratory conditions was investigated during 1948–50. They were kept in batches of 1–35 in glass tubes 8 ins. long and 3 cm. in diameter with a cotton plug at each end; a preliminary test showed that the size of the batch within this range had no effect on the rate of mortality. Water, which was essential for survival, was provided by a wick in a capillary tube passed through the bottom plug, and nutrients were dissolved in the water or offered separately in the tube.

The Simuliids used are termed cage flies and wild flies; the cage flies had emerged on the previous day in a cage over a stream and the wild flies had been collected away from the stream. Most of the wild flies had taken a full or partial blood-meal when they were caught. *S. venustum* comprised 95 per cent. of the test insects, but *S. decorum* Wlk. predominated in one experiment. All the flies used were females except in one test in which the sexes of *S. venustum* (cage flies) were compared and the females lived longer than the males. Under the same conditions, the cage females died off more quickly than the wild ones, probably because the latter did not include weaklings that died soon after emergence. The nutrients comprised various forms of sugar, protein or both, offered dry or in solution, and the flies lived longest when the nutrient was sucrose crystals. Wild flies given sucrose crystals and kept at outdoor temperatures during June–July survived for up to 37 days; 70, 38, 13 and 4 per cent. were alive after 5, 10, 15 and 20 days, respectively. The rates of mortality in periods of 24 hours rose and fell with the temperature. When several tubes of Simuliids that had been exposed to outside temperatures for eight days in August were kept at an average temperature of 52°F., a female of *S. vittatum* Zett. and one of *S. decorum* survived for 61 and 63 days, respectively, and seven others survived for 33–35 days. Some of the wild flies were allowed to feed on ducks and were then given sucrose. Most of them did not live so long as those given sucrose only, and none lived longer. Their death-rates were higher after a full blood-meal than after a partial one and when the ducks were heavily infected with *Leucocytozoon* [*simondi*] than when they were not infected.

Fredeen (F. J. H.), Arnason (A. P.), Berck (B.) & Rempel (J. G.). **Further Experiments with DDT in the Control of *Simulium arcticum* Mall. in the North and South Saskatchewan Rivers.**—*Canad. J. agric. Sci.* **33** no. 4 pp. 379–393, 1 map, 10 refs. Ottawa, 1953.

Experiments with DDT against larvae of *Simulium arcticum* Mall. in the North and South Saskatchewan Rivers [*R.A.E.*, B **38** 167] were continued in 1949–51 with field tests for the development of a practical control programme. Two tests were made in each of the three years, and all but the last one were in the South Saskatchewan. A concentrate of 33 per cent. w/w DDT in methylated naphthalene was used undiluted in 1949 and diluted with kerosene to give a 10 per cent. solution in 1950 and 1951. Application was from variously spaced cans or drums on bridges or ferries. It was at the rate of 0·39 part DDT per million for 24 minutes in the first test and 0·089–0·115 p.p.m. for 12–17 minutes in the others. Larvae were practically eliminated for distances of 40–115 miles. The results were best when the water was turbid with finely divided inorganic material. In the first test in 1950, the water contained 551 p.p.m. suspended solids and larvae were almost completely eliminated for 115 miles, whereas in the second test, when the water contained only 183 p.p.m. suspended solids, the larvae were almost eliminated at 42 miles, but about 10 per cent. survived at 80. DDT was extracted from suspended solids from water samples collected at various depths and distances from the river banks as far as 68 miles downstream from the point of application. At this distance, from 0·24 to 2·26 mmg. DDT per gm. suspended solids was extracted, equivalent to 1 part DDT in from 4,385 to 685 million parts water. As Simuliid larvae ingest particles suspended in water, it is suggested that the effectiveness of single applications over long distances in turbid water is due to ingestion of DDT adsorbed by solids rather than to contact with it. Other aquatic larvae were much less affected by the treatment than Simuliid larvae and in the 1950 tests were apparently unharmed by concentrations that eliminated Simuliid larvae, presumably because they did not ingest suspended matter.

Fish were killed during the tests in 1949, apparently because the concentrate had a specific gravity of 1·04 and they ingested globules that had settled on the river bed. In laboratory tests, fish were not affected by immersion for three hours in water containing as much as 100 p.p.m. DDT in a solution with a specific gravity of less than 1·0 or by the consumption of aquatic insects killed by DDT. In the field tests in 1950 and 1951, when kerosene was used to lighten the concentrate so that it had a specific gravity of 0·9, there was no apparent mortality of fish.

On the basis of the results obtained, recommendations are made for controlling Simuliids on the Saskatchewan Rivers with one or two applications of 10 per cent. DDT in kerosene or fuel oil providing a concentration of about 0·1 p.p.m. DDT for 15 minutes at the point of application, preferably when the water is turbid. It is suggested that control in small streams with clear water might be improved by adding finely divided inorganic material with marked properties for adsorbing DDT or by using DDT incorporated in such material.

Thomson (R. C. Muirhead-) & Mercier (E. C.). **Factors in Malaria Transmission by *Anopheles albimanus* in Jamaica. Part II.**—*Ann. trop. Med. Parasit.* **46** no. 3 pp. 201–213, 3 refs. Liverpool, 1952.

In an investigation of malaria in Jamaica [*R.A.E.*, B **42** 85], a limited parasite survey in three selected areas near Kingston showed that in two

of them *Plasmodium malariae* was nearly or quite as plentiful as *P. falciparum*, which had been thought to be dominant. *P. vivax* was very rare. Nearly 3,000 females of *Anopheles albimanus* Wied. and 73 of *A. grabhamii* Theo. were caught in the three areas, mainly at sunset, between April 1950 and April 1951 and dissected within two days of capture. No gland infections were found in them, although *A. albimanus* is undoubtedly the main vector of malaria in the island and is often the only Anopheline present. Previous records of dissection also indicate a low natural infection rate [*cf.* **19** 213]. However, it is possible that the sunset peak [**42** 85] is largely composed of recently emerged females. Four out of 36 engorged females of *A. albimanus* taken at dawn on two mornings from a room in which a crescent-carrier was sleeping, developed gland infections after being kept for ten days, but there is no proof that they would have lived long enough in nature to become infective.

The localities investigated were an extensive swampy area west of Kingston and two coastal villages (Bull Bay and Grants Pen) several miles to the east, and various factors influencing malaria transmission are discussed on the basis of observations in them. In Bull Bay, a severe local epidemic had occurred in January 1950 and was found to have been related to intense and uncontrolled breeding of *A. albimanus* in extensive seasonal brackish ponds that are dry during the summer months. It appeared that in such an area of highly seasonal breeding, the development of an outbreak depends on the occurrence of a large output of Anophelines at a time when numerous relapses are brought on by sudden spells of cold weather. An additional factor favouring transmission was the scarcity of donkeys and cattle. Animals were also scarce at Grants Pen, where parasite rates were high, but few females of *A. albimanus* were caught and only 52 were available for dissection. The swampy area west of Kingston differs from the two village areas in that favourable breeding places for *A. albimanus* are available throughout the year and it becomes very numerous at times, particularly during the rainy season. Despite this, the malaria rate in children is very low. Cattle are numerous and it is evident that few of the mosquitos are infected, as over 2,000 of the females of *A. albimanus* dissected were from this area. Malaria transmission is probably maintained by sheer weight of numbers.

In estimating which age-group of the human population is mainly responsible for infecting Anophelines, the infectiveness of the gametocyte-carriers to mosquitos [*cf.* **42** 85] and the extent to which mosquitos bite them in nature must both be taken into account. Children 7–14 years of age seem to be of particular interest, as gametocyte-carriers of this age can be very infective, are often bitten by mosquitos and seldom use anti-malarial drugs.

Jackson (C. H. N.). **A new specific Character for Tsetse-flies** (*Glossina*) **of the** *morsitans* **Group.**—*Ann. trop. Med. Parasit.* **46** no. 3 pp. 218–219, 2 pls., 1 ref. Liverpool, 1952.

Figures and descriptions are given of the ninth tergo-sternum in males of *Glossina morsitans* Westw., *G. swynnertoni* Aust., *G. pallidipes* Aust., *G. longipalpis* Wied. and *G. austeni* Newst. Though other good characters have served to distinguish these five species, the ninth tergo-sternum, which is both conspicuous and characteristic of each, appears to be as useful as other criteria provided by the male genitalia. It seems particularly useful in distinguishing the closely related *G. pallidipes* and *G. longipalpis*, the difference between the constricted slot in the former and the square one in the latter being immediately visible. Figures are also given

of the ninth tergo-sternum in hybrids from reciprocal crosses between *G. morsitans* and *G. swynnertoni* and in *G. morsitans submorsitans* Newst., but it is not yet known whether the character will prove useful in separating the races of *G. morsitans*.

Hopkins (C. A.) & Nicholas (W. L.). *Culicoides austeni*, **the Vector of** *Acanthocheilonema perstans*.—*Ann. trop. Med. Parasit.* **46** no. 3 pp. 276–283, 10 refs. Liverpool, 1952.

Sharp, working in the British Cameroons, first described the development of *Acanthocheilonema perstans* in *Culicoides austeni* C., I. & M. [*R.A.E.*, B **16** 155] and concluded that *C. austeni* and probably also the day-biting *C. grahami* Aust. were the vectors of *A. perstans* in nature. The validity of this conclusion has recently been questioned [**41** 98–99], and the ability of the midges to transmit *A. perstans* was examined in the Kumba area [*cf.* **42** 86]. The Africans used as donors were fly-boys who had no filarial infection other than *A. perstans*. Of 71 reared females of *C. austeni* fed on these men, 29 became infected and 40 developing filarial larvae were found in them. These were inactive " sausage " forms in the thorax until the fifth day, after which elongate motile forms were found. By the ninth day, most of these had migrated to the head, where they remained active until at least the 17th day. Correlation between the expected number of microfilariae in the volume of blood ingested and the number found developing in the flies was fair. Eleven females of *C. austeni* caught in nature after they had fed on fly-boys infected with *A. perstans* were found to contain 18 filarial larvae, whereas 37 others caught at the same time on fly-boys free from filariasis were all uninfected. It is concluded, though it has not been proved, that *C. austeni* is a vector of *A. perstans* in the area where the observations were made. Of 418 females of *C. grahami* caught after they had fed on the men used in the experiment with reared females of *C. austeni*, only two were infected on dissection (each with one active larva in the head), and 350 caught before taking a blood-meal were all uninfected. The complete lack of correlation between the number of larvae expected to be ingested and the number found suggests that microfilariae of *A. perstans* are usually not ingested by *C. grahami* or do not develop in it. However, the development of the two larvae present suggests that the physiological environment in *C. grahami* must be similar to that in *C. austeni*. It is concluded from the available evidence that *C. grahami* is a possible, though poor, vector of *A. perstans*.

The possible importance of even a poor vector, if it is abundant, and the relative importance of *C. austeni* and *C. grahami* in the transference of *A. perstans* in the rain-forest of the British Cameroons, are briefly discussed. Although the incidence of infection with *A. perstans* in the population is high, the infective density of microfilariae in the blood is low. This fits well with the concept that *Culicoides* spp. are vectors, as only a few larvae occur in each of these midges so that infection in man must be the result of the accumulation of many small infections by one or two larvae at a time. As the chance of being bitten is fairly even throughout the community, this leads to the infective larvae being evenly distributed.

Atchley (F. O.). **Densities of** *Anopheles*, **Sporozoite Rates in** *Anopheles*, **and Incidence of Malaria in an Area of South Carolina.**—*Amer. J. trop. Med. Hyg.* **1** no. 5 pp. 743–746, 3 refs. Baltimore, Md., 1952.

In an area bordering the Santee Reservoir in east-central South Carolina where malaria had formerly been endemic, annual examination of over

20,000 human blood films showed the percentage positive to fall from 0·39 in 1947 to 0·04 in 1948, 0·01 in 1949 and 0 in 1950. There was no corresponding decrease in the numbers of females of *Anopheles crucians* Wied. and *A. quadrimaculatus* Say taken in some 30 collecting stations (mainly occupied stables) or in their sporozoite rates as estimated by examination of several thousand females of each species annually. In the four years, the average number of females of *A. crucians* taken weekly per station and (in brackets) the percentages with positive glands were 6·8 (0·16), 12·9 (0·06), 13·8 (0·09) and 2·6 (0·06). The corresponding figures for *A. quadrimaculatus* were 2·5 (0·09), 15 (0·04), 10·8 (0·08) and 1·6 (0). Females of both species with positive glands were found in 1951. No significant relationship was observed between numbers of positive Anophelines and particular months or places of collection. The identity of the sporozoites in the Anophelines is unknown. They failed to produce infections when injected on several occasions into human volunteers and birds.

Weyer (F.). **The Behavior of *Rickettsia akari* in the Body Louse after artificial Infection.**—*Amer. J. trop. Med. Hyg.* **1** no. 5 pp. 809–820, 7 figs., 13 refs. Baltimore, Md., 1952.

Rickettsia akari, the agent of rickettsialpox, was transmitted to *Pediculus humanus humanus* L. by injection of peritoneal exudate of infected mice into the rectum or through the vagina into the body cavity or by injection of diluted blood of sick mice into the rectum. Development in the louse was regular and intensive. When injection was into the rectum, the rickettsiae multiplied in the cells of the midgut and did not invade the rest of the alimentary canal or other tissues. They multiplied only moderately and did not cause the premature death of the louse, though they sometimes destroyed or detached some of the cells and escaped through the partly damaged walls either into the lumen of the stomach or less frequently into the haemocoele. In the haemocoele, whether they had entered through the stomach wall or by injection through the vagina, they multiplied intensely outside the cells and caused damage from which the louse died in a few days. Through rectal transmission of ground stomachs or haemocoelic fluid, *R. akari* was maintained by serial passage in lice without losing virulence and pathogenicity for the mouse. The faeces of the lice also contained virulent rickettsiae.

Gibson (C. L.) & Dalmat (H. T.). **Three new potential intermediate Hosts of Human Onchocerciasis in Guatemala.**—*Amer. J. trop. Med. Hyg.* **1** no. 5 pp. 848–851, 6 refs. Baltimore, Md., 1952.

Simulium ochraceum Wlk., *S. metallicum* Bellardi and *S. callidum* (Dyar & Shann.) have long been considered to be the intermediate hosts of *Onchocerca volvulus* in Guatemala and Mexico [*R.A.E.*, B **39** 213, etc.]. With a view to determining whether or not they are the vectors in all the onchocercosis zones of Guatemala, a survey was made over a period of three years throughout the country in which over 160,000 Simuliid larvae, 115,000 pupae and about 70,000 adults feeding on man were collected and 78,500 of the pupae were reared to the adult stage. The results indicated that in some areas of the almost inaccessible onchocercosis zone of Huebinetenango, contiguous with the disease zone in Chiapas, Mexico, *S. ochraceum* is absent and *S. veracruzanum* Vargas, Martínez & Díaz is the principal species attacking man. In the lower altitude range of the Yepocapa onchocercosis zone (below 2,500 ft.), *S. exiguum* Roub. is the

dominant biting species, while *S. haematopotum* Malloch seems to replace *S. ochraceum* in importance in other regions of the zone. Several hundred adults each of *S. exiguum*, *S. veracruzanum* and *S. haematopotum* were therefore allowed to feed on volunteers heavily infected with microfilariae of *O. volvulus*, and dissected as soon as they died. All three species were found to support the development of the larvae and must therefore be considered potentially able to transmit *O. volvulus* in the parts of the endemic zone in which they replace or supplement the generally recognised vectors.

Trapido (H.). **Modified Response of *Anopheles albimanus* to DDT residual House Spraying in Panama.**—*Amer. J. trop. Med. Hyg.* **1** no. 5 pp. 853–861, 3 refs. Baltimore, Md., 1952.

Experiments with deposits of DDT in houses as an anti-malaria measure where the vector is *Anopheles albimanus* Wied. were begun in 1944 in the middle Chagres River area of Panama. By the second season, it was apparent that the treatment was reducing the numbers of mosquitos in the houses and the percentages that were engorged, and selectively increasing the mortality rate of those that had engorged [*R.A.E.*, B **37** 213]. Malaria incidence also fell suddenly, so that soon there were virtually no locally acquired cases. After the end of 1946, routine spraying was continued at intervals of about four months, but detailed mosquito counts were discontinued.

Counts were resumed in January 1952, however, to ascertain whether any resistance or change in reaction to DDT had developed in *A. albimanus*. The observations were made in the test village of Gatuncillo and in another village, which had been kept as a control until September 1947 and treated thereafter. The findings of the first four months are given. They show that the average number of *A. albimanus* per house had returned to the pre-treatment level and there was no longer a marked difference between the survival rates 24 hours after capture of engorged and unengorged females, but the reduction effected by the early treatments in the proportion of engorged females among those taken was being maintained. The change in the response of *A. albimanus* to the deposits may be due to the selection of a population that had developed resistance or of one with an enhanced predisposition to fly restlessly instead of remaining in contact with the DDT deposits [*cf.* **34** 189; **42** 54], or to a combination of both. Resistance cannot be measured on the basis of the field observations described, but there was evidence of increased activation and greater positive phototropism. The modification in the response of *A. albimanus* to DDT deposits had not been reflected in any rise in the malaria rates at the villages.

Sarles (M. P.) & Vandegrift (W. B.). **Chronic oral Toxicity and related Studies on Animals with the Insecticide and Pyrethrum Synergist, Piperonyl Butoxide.**—*Amer. J. trop. Med. Hyg.* **1** no. 5 pp. 862–883, 1 graph, 9 refs. Baltimore, Md., 1952.

The effect of piperonyl butoxide on mammals was studied in tests in which single large doses and limited numbers of fairly large doses were given to rats, graded doses over a long period to rats and dogs, a low dose over a long period to a goat and low and moderate doses for a limited period to monkeys. The susceptibilities of the various animals and of the sexes were found to differ little. Piperonyl butoxide had a relatively low toxicity for all of them, and there was no indication of cumulative toxic effect on

the second and third generations of rats fed on food containing as much as 10,000 parts per million piperonyl butoxide. The outstanding effects of continued ingestion of 10,000 and 25,000 p.p.m. piperonyl butoxide were anorexia, wasting, reduced food consumption, reduced or lost ability to reproduce and accentuation of concomitant natural disease. Results of an experiment continued over a period of two years, in which various amounts of piperonyl butoxide were added to the standard diet provided in unlimited quantities for pairs of rats, indicated that a dose of 100 p.p.m. was not toxic, one of 1,000 p.p.m. was tolerated with no adverse effect on health and the addition of one-sixth as much pyrethrins to a ration containing it did not increase toxicity, a dose of 10,000 p.p.m. was tolerated with moderate toxicity, and one of 25,000 p.p.m. killed all the 24 rats receiving it between 4 and 68 weeks after the beginning of the test. Findings in a similar experiment, in which various doses of piperonyl butoxide were fed six times a week by capsule to dogs over a period of one year, indicated that (in converted degrees of toxicity) about 80 p.p.m. was non-toxic; about 700 p.p.m. was tolerated with no adverse effect on health, about 3,000 p.p.m. was tolerated with moderate toxic effect and about 11,000 p.p.m. was fatal in 4–15 weeks.

The main lesions in the livers of rats and dogs receiving moderately toxic doses were moderate numbers of acidophil and hyalin-necrosis cells, moderate dystrophy and dysplasia and advanced hydropic swelling. The lesions were accentuated in cases of concomitant natural disease. It was shown that when a dog received a large dose of piperonyl butoxide this was quickly eliminated in the faeces and only traces appeared in the urine. Piperonyl butoxide was not carcinogenic for the liver, did not exert a malignant tumorogenic effect on the general tissues or on the endocrine or mammary glands, and did not have an indirect general tumorogenic effect through disturbance of the endocrine glands. The safe human tolerance for chronic ingestion of piperonyl butoxide was estimated, after allowing for a 100-fold safety factor, to be 42 parts per million in all the food eaten.

Yeoman (A. H.) & Van Leeuven [*i.e.* Leeuwen] (E. R.). **Explosion Characteristics of insecticidal Aerosols.**—*Agric. Chem.* **9** no. 4 pp. 75, 77, 2 refs. Baltimore, Md., 1954.

The widespread use of large generators to apply insecticidal aerosols indoors in the United States during the last six years has resulted in several serious accidents in which buildings of various kinds have been destroyed by explosions, and the explosiveness of various solvents and oils commonly used in aerosol formulations was therefore tested under conditions as close as possible to those of actual use. An open-headed metal drum, 9·4 cu. ft. in capacity, was used; the open end had a hinged cover that opened readily at a pressure of 5 lb. per sq. in., and the other end was equipped with a shuttered opening for the introduction of the aerosol. A burning plumber's candle was put half way along the drum, and aerosols with mass median diameters of approximately 15 and 5 μ were introduced at known rates until explosions occurred. There was some leakage from the drum, and the volume of air required to atomise the amount of liquid needed for explosion was added to the volume of the drum to give the space in which explosion occurred.

There was no difference between the fine and medium aerosols in the amount of volatile solvent required for explosion, xylene, acetone and cyclohexanone exploding at amounts equivalent to 39, 47·5 and 54·5 U.S. gals. per 100,000 cu. ft. and carbon tetrachloride, methylene chloride and tetrachloroethylene (perchloroethylene) not exploding at all at concentrations

sufficient to extinguish the flame, but Sovacide 544C, kerosene and Deobase exploded at 40·5, 49·5 and 49·5 U.S. gals. per 100,000 cu. ft. at the small particle size and at 62, 80 and 81 U.S. gals. at the larger one, and Texaco 300 and Diol 50 at 36 and 48 U.S. gals. at the smaller one and not at all at the larger. The addition of the non-explosive tetrachloroethylene to Deobase, Velsicol AR-60 and Sovacide 544C did not reduce their inflammability at proportions of less than 1:1; the results were not conclusive, but it would probably be necessary to add at least 50 per cent. of a non-explosive solvent to raise the explosion concentration of a mixture.

It is evident that aerosols containing solvents or oils of the types tested do not present an explosion hazard if properly dispersed in a building at the usual rate of 1 U.S. gal. formulation per 50,000 cu. ft. of free air space; explosions that have occurred can be explained only by a considerable overdosage, probably as a result of the discharge of the entire contents of a large machine into a confined area in which an open flame or spark was present.

RIEMSCHNEIDER (R.). **Zur Weiterentwicklung der Insektizide der Chlorkohlenwassertoffklasse. Kontakt-Insektizide auf Halogenkohlenwasserstoffbasis III.** [Contribution to the further Development of the Chlorinated-hydrocarbon Group of Insecticides. Contact Insecticides based on Halogenated Hydrocarbons III.]—*Euclides* **11** pp. 373–381; **12** pp. 35–41, 91–105, refs. Madrid, 1951–52. (With Summaries in Spanish and English.)

In this third part of a series [*cf. R.A.E.*, B **40** 17], the author reviews the chlorinated hydrocarbons that were used as insecticides, in all cases as fumigants, before the discovery of the contact action of DDT, gives a list of the principal chlorinated insecticides of the diene and terpene groups, showing their structural formulae, and discusses from the literature and his own observations the chemical constitution and preparation of chlordane, heptachlor, aldrin, dieldrin, toxaphene and a few related compounds. The first four are dienes, and toxaphene is a member of the terpene group.

Technical chlordane (known in Germany as technical M 410) has been shown to comprise a mixture of compounds, including two isomers of chlordane [*cf.* **40** 172]. The author and co-workers have prepared four isomers of chlordane, with melting-points of 101–103, 102–104, 137–139 and below 73°C., respectively. These showed widely differing toxicity to insects and are not all stereoisomers. The position of one of the chlorine atoms in heptachlor is in doubt, and the detailed composition of toxaphene, which is probably a mixture and is referred to as octachloroendomethylenetrimethylcyclohexane (M 414) [*cf.* **40** 28, 207], is still unknown. Two other chlorinated terpenes that have been stated to possess insecticidal properties are cis-1,8-dichloro-p-menthane and 2,6,7-trichlorocamphane. The author has prepared tetra- and pentachloro-1-methyl-4-isopropylcyclohexanes of undefined constitution but consisting chiefly of the tetra- and pentachloro derivatives of p-menthane, and found that their toxicity to insects depended much on the conditions of synthesis.

STÜBNER (K.). **Ein fluoreszenzoptisches Verfahren zum Nachweis von Hexa und DDT.** [A fluorescent optical Procedure for the Detection of BHC and DDT.]—*Anz. Schädlingsk.* **26** pt. 1 pp. 9–12, 3 figs., 3 refs. Berlin, 1953.

The author's method for the fluorescent microscopic detection of DDT [*R.A.E.*, B **42** 44] cannot be applied directly to BHC in an inert carrier, since BHC is not sufficiently fluorescent to be easily distinguished from the

other components. It can be used, however, if the BHC is first treated with a fluorescent stain. This is done by mixing the BHC with 0·2–1 per cent. of its weight of stain, heating to melting point, stirring and cooling, followed by recrystallisation and grinding of the BHC. Experiment is necessary to establish the exact proportion of stain required. This treatment also improved the results with DDT [*cf. loc. cit.*]. Tests were carried out with DDT and various grades and isomers of BHC, and tables are given showing suitable stains and light filters for each, together with the colours obtained.

Maelzer (D. A.) & Kirk (R. L.). **A preliminary Study of the Genetics of DDT Resistance in Houseflies.**—*Aust. J. biol. Sci.* **6** no. 2 pp. 244–256, 2 figs., 15 refs. Melbourne, 1953.

A study is reported of the responses to technical DDT of a highly resistant strain of house-flies [*Musca domestica* L.] from Illinois (Multi-X), a non-resistant strain maintained since 1940 at Canberra, and crosses between them. Topical applications were made to the dorsal surface of the thorax at 0·002 ml. solution of DDT in acetone per fly. In initial dosage-mortality tests, carried out to study possible variability within the strains, the log-probit curve of the Canberra flies was linear and resembled that of other non-resistant strains. That of the Illinois strain, on the other hand, was highly asymmetrical; it was linear until a dose of 4 mmg. per fly was reached, when mortality was about 50 per cent., but no further increase in mortality was observed at higher doses (up to 96 mmg.). It appeared that the Illinois population was genetically heterogeneous, and was composed of individuals that are "weak" (unable to withstand a single dose of 4 mmg. per fly) or "strong" (able to survive 4–96 mmg.). A method of testing individual flies was therefore developed that enabled some distinction to be drawn between flies resembling Canberra stock, and weak and strong Illinois types. It consisted in applying 8 mmg. DDT per fly and using knockdown as the criterion of response. The Canberra flies showed 50 and 100 per cent. knockdown in one and two hours, and the Illinois flies showed 0, 10, 40 and 47 per cent. after one, two, six and 24 hours. A somewhat similar knockdown response occurred when the flies were exposed to a DDT deposit, the pattern in both cases being in agreement with the conclusions from the dosage-mortality curves.

In crossing experiments between Canberra and Illinois flies, the response to the 8 mmg. dosage was used to differentiate the Illinois parents and the offspring. The Illinois parents that were knocked down in less than six hours were classed as weak, and those that were not, as strong; none of the latter was knocked down in 24 hours. Eight crosses between Canberra and weak Illinois flies were carried through to an F_2 generation. Although the pattern of response was highly variable, there was little difference between the F_1 and F_2 generations, the latter being only slightly more variable than the former. All the F_1 flies were knocked down in less than six hours, and 98·2 and 100 per cent. of the F_2 flies in six and 24 hours, respectively. The knockdown pattern for F_1 and F_2 flies was in no case identical with either that for Canberra flies alone or for weak Illinois flies alone. The variability in response over a time period critical for discriminating typically Canberra knockdown responses from Illinois responses suggests that both genetic and other factors contribute to the differences in pattern. Five crosses between Canberra flies and strong Illinois flies were carried through to an F_2 generation, and mortality after 24 hours was recorded. The crosses fell into two groups with regard to resistance. Two showed no F_1 mortality and about 30 per cent. F_2 mortality, whereas the

other three produced a preponderance of non-resistant flies in both generations. The differences between the groups and the F_2 differences between the last three crosses were significant and the group differences suggest that a single dominant gene exercises a major influence in determining survival. If so, the Illinois parents of the first group would be homozygous and those of the second heterozygous. The numbers of F_2 resistant flies in the crosses of the second group were significantly smaller than would then be expected, but this could be explained if the dominant gene reduced the fertility of flies that carry it. Numerous attempts to establish cultures from crosses between pairs of strong Illinois flies yielded only a few adults in the first generation, and the stock was never maintained for more than two or three generations. Other factors, also, are almost certainly involved. The occurrence of two genetically distinct types of flies in a resistant strain emphasises the danger of basing discussions of resistance on LD50 values.

The development of resistance to DDT in a number of laboratory and field strains of *M. domestica* is briefly reviewed, and an attempt is made to interpret this development in the light of the present experiments. It appears that most field populations must be polymorphic with respect to factors controlling resistance, and that the evolution of a resistant strain involves an initial relatively slow accumulation of a number of independent factors, each of which singly or in combination confers resistance, followed by a rapid rise in resistance owing to selection of a highly resistant phenotype, controlled probably by a single pair of alleles. This highly resistant population can never be rendered homogeneous because of the low fertility associated with the high resistance factor. It seems likely that this factor cannot be selected initially because the advantage it confers is outweighed by the lower fertility rate associated with it.

Gersdorff (W. A.), Mitlin (N.) & Nelson (R. H.). **New House Fly Insecticides.**—*Soap & sanit. Chem.* **30** no. 2 pp. 133, 159, 2 refs. New York, N. Y., 1954.

The toxicities of three recently developed organic phosphorus compounds to *Musca domestica* L. were compared by the turntable method [*R.A.E.*, B **26** 246]. The compounds were O,O-diethyl O-(2-isopropyl-4-methyl-pyrimidyl(6)) thiophosphate (Diazinon), O,O-diethyl O-(3-chloro-4-methyl-umbelliferone) thiophosphate (Bayer 21/199) and a dialkyl phosphonate referred to as Bayer L 13/59. All were of technical grade. Parathion and pyrethrins containing 52 per cent. pyrethrin I and cinerin I were used as standards of comparison. Stock solutions of Diazinon, parathion and pyrethrins were prepared in refined kerosene, but 20 per cent. dry acetone was used as an auxiliary solvent for the other two because of their lower solubility. The phosphorus sprays caused virtually no knockdown of flies in 25 minutes and the pyrethrins complete knockdown. Mortality data are summarised in a table, which shows that on the basis of concentrations required for 50 per cent. mortality, parathion, Diazinon, 21/199 and L 13/59 were, respectively, about 61, 31, 21 and 4·5 times as toxic as pyrethrins.

Calsetta (D. R.) & Starr (D. F.). **Ryania for the Control of Cockroaches in an Insecticide Testing Laboratory.**—*Pest Control* **21** no. 9 pp. 18, 20, 4 refs. Painesville, Ohio, 1953.

Trouble has been experienced in an insecticide-testing laboratory in New York from colonies established by cockroaches that escaped from cultures.

An insecticide for their control must be highly toxic to them as a long-lasting deposit, non-toxic to man, and non-volatile so that there is no danger of destruction of cultures of insects or development of immunity in them. As ryania dust is safe and convenient to handle and has shown high toxicity to cockroaches, Ryanicide 100 (100 per cent. ryania powder) was tested in December 1951 in the room in which insects were being reared. It was spread round the base of the walls in a layer about $\frac{1}{8}$ inch thick and 2 ins. wide. More than 300 cockroaches in all stages of development were found dead or dying on the floor next morning; they comprised about equal numbers of American and German cockroaches [*Periplaneta americana* (L.) and *Blattella germanica* (L.)]. After that time, *Periplaneta* and adults of *Blattella* were rarely seen, but some first- and second-instar nymphs of *Blattella* were found. The dust was changed every six months except under the sink where it was changed every three months owing to exposure to damp. About 50 dead or dying young nymphs of *Blattella* were found after the first fresh application under the sink. Oriental cockroaches [*Blatta orientalis* L.] escaped into the room about six months after the initial application and about three dozen adults were found dead or dying within two days, about six the next day and only occasional individuals thereafter. No noticeable effect was produced on the other insects in rearing containers, and no evidence of resistance was seen in tests made over a period of 18 months. Dust that had been on the floor for six months was found to be active in a settling dust test against large nymphs of *Periplaneta*. When no more dead or dying cockroaches were being found on the floor, nymphs of *Blattella* were seen to be surviving on the shelves, and treatment of the edges of these, following removal of insect cultures, glassware etc., resulted in the finding of 40 dead cockroaches on the first day, 100 on the second and 35 on the third. Occasional survivors continued to appear owing to the existence of inaccessible hiding places.

Akwei (E.). **Planning the Control of Sleeping Sickness: a Sequel.**—*Trans. R. Soc. trop. Med. Hyg.* **46** no. 4 pp. 437–448, 2 maps, 14 refs. London, 1952.

A re-survey was made in 1949–50 of sleeping sickness [caused by *Trypanosoma gambiense*] in the Lawra district of the north-western Gold Coast, where K. R. S. Morris had carried out an extensive campaign for the eradication of the vectors [*Glossina palpalis* (R.-D.) and *G. tachinoides* Westw.] along the river Kamba [*R.A.E.*, B **40** 102] in combination with mass treatment of cases. Part of the adjoining Tumu district to the north-east was also re-surveyed. The universal blood-film technique was used. The incidence of the disease observed among some 80,000 persons examined, which was less than 0·1 per cent. in each district, indicated that sleeping sickness had ceased to be a public-health problem in the zone. More than half the cases were accounted for by an outbreak in the Kamba-Bekpong watershed in south-eastern Lawra. The banks of the Bekpong had remained infested with *Glossina* in 1949. The finding of this outbreak served to emphasise the effectiveness of Morris' technique in a river basin and to reveal its limitations with regard to a watershed. The latter is not surprising as the technique is based on the concept that the *Glossina* community of each river system forms a natural biological unit. The most highly infected village outside the epidemic zone was in the Kamba-Kulpawn watershed in the Tumu area. Here, four of the five infected persons were women, indicating a waterpoint infection and the presence of riverine *Glossina* on the Kulpawn. The fact that no epidemic developed may be fortuitous, but

it may, on the other hand, indicate a local difference between watersheds, which could be an important factor in determining the onset of outbreaks. The finding of this factor might obviate the necessity of clearing all streams draining from watersheds to eradicate the riverine *Glossina*, as now appears necessary. The discovery of the outbreak in south-eastern Lawra was due to the use of the universal blood-film technique. This brings into prominence an old theory that after an infective bite trypanosomes first appear in blood, then in blood and gland juice and finally in blood, gland and cerebro-spinal fluid. Views on the relation between the findings in the peripheral vascular circulation and the stage of evolution of the disease are discussed.

Logan (J. A.) & others. **The Sardinian Project: an Experiment in the Eradication of an indigenous malarious Vector.**—*Amer. J. Hyg. Monogr. Ser.* no. 20, 9 × 6 ins., xxix + 415 pp., col. frontis., 56 pls., 37 figs., 1 fldg. map, 13½ pp. refs. Baltimore, Md., Johns Hopkins Press, 1953. Price $7.50.

Details are given of the campaign against *Anopheles maculipennis labranchiae* Flni. in Sardinia in 1946–50, which resulted in the elimination of malaria transmission but allowed small numbers of the mosquito to persist in isolated places [*R.A.E.*, B **40** 194]. The campaign is considered solely as an experiment in the eradication of an indigenous insect from a selected but considerable area. Stress is consequently laid on errors and uncertainties, and many deficiencies in knowledge of insect biology are brought out.

In the first chapter, the island and its resources and people and the origins of the experiment are described. Accounts are then given of the year-by-year course of the campaign and the measures taken. The basic measures comprised spraying the interiors of houses with DDT to leave a toxic deposit against the overwintering adults and applying larvicides in summer, if necessary after clearing and drainage. Organisation and procedure for surveying for adults and larvae to estimate the success of the operation as it progressed, which is a very important part of such an experiment, are also described. A chapter is devoted to the epidemiology of malaria in Sardinia and the effect of the Anopheline control operations on it. In others, finance and administration, and the working of the inspection and quarantine service set up to prevent the reintroduction of *A. m. labranchiae* or the introduction of other vectors are dealt with. As the co-operation of the population in indoor spraying depends largely on the effectiveness of the measures taken in controlling house-flies (*Musca domestica* L.), which constitute a more easily recognised nuisance than the Anophelines, a chapter on fly control is included.

In a final critical review, the reasons for the failure of eradication are examined and the plan that would have been followed had present knowledge been available is outlined. The eradication of an indigenous vector under the conditions prevailing was shown to be much more difficult than that of an introduced species, such as *Anopheles gambiae* Giles in Brazil [*cf.* **31** 215; **32** 159]. The house treatment against the adults was found to have great value in controlling malaria, but to contribute little to the eradication of the vector. It is concluded that the eradication of an indigenous Anopheline is too costly to be justified in most cases, as a campaign of suppressive spraying would be enough to check malaria transmission, but it would be desirable if it could be carried out as part of a general conservation and development programme. In addition to banishing

malaria, the work in Sardinia made substantial areas of land available for agriculture and increased the amenities of the whole island.

"The Anopheline Fauna of Sardinia" is the subject of an appendix by T. H. G. Aitken, and "Biological Considerations" (characteristics that make the eradication of any given species appear practicable) of one by H. Trapido. Others comprise the decree setting up and defining the functions of ERLAAS (Ente Regionale per la Lotta Anti-Anofelica in Sardegna), the original estimate of costs, a list of staff, a description of an insecticide mixing plant and recommendations made to the Italian Government on the conclusion of operations in the autumn of 1950.

McNeel (T. E.) & Ferguson (F. F.). **Mosquito Distribution and Abundance in the Arkansas-White-Red River Basins.**—*Publ. Hlth Rep.* **69** no. 4 pp. 385–390, 59 refs. Washington, D. C., 1954.

A list is given of some 100 species of mosquitos recorded in published reports and recent unpublished observations from that part of the south-central United States that lies in the basins of the White, Red and Arkansas Rivers. The States of this area in which each has been found are shown (with an indication of new State records) and also the relative abundance of the species and their importance in relation to man and animals as disease vectors or otherwise.

Papers noticed by Title only.

Sasa (M.) & Jameson jr. (E. W.). **The Trombiculid Mites of Japan.**—*Proc. Calif. Acad. Sci.* (4) **28** no. 5 pp. 247–321, 45 figs., 41 refs. San Francisco, Cal., 1954.

Weidner (H.). **Bestimmungstabellen der Vorratsschädlinge und des Hausungeziefers Mitteleuropas.** [Keys to the Store Pests and Household Vermin in Central Europe.]—2nd revd. edn., $9\frac{3}{4} \times 6\frac{3}{4}$ ins., viii + 234 pp., 272 figs., refs. Jena, G. Fischer Verlag, 1953. Price *DM.* 14.50. [*Cf. R.A.E.*, B **26** 77.]

Smart (J.). **Instructions for Collectors No. 4a. Insects. Revised by W. E. China.**—3rd edn., $6\frac{3}{4} \times 4\frac{3}{4}$ ins., x + 178 pp., 43 figs. London, Brit. Mus. (Nat. Hist.), 1954. Price 3*s.* 6*d.*

Feinstein (L.) & Jacobson (M.). **Insecticides occurring in Higher Plants.**—*Fortschr. Chem. org. Naturst.* **10** pp. 423–476, 272 refs. Vienna, 1953. [See *R.A.E.*, A **42** 228.]

Gillies (M. T.). **The Duration of the Gonotrophic Cycle in *Anopheles gambiae* and *Anopheles funestus*, with a Note on the Efficiency of Hand Catching.**—*E. Afr. med. J.* **30** no. 4 pp. 129–135, 1 graph, 4 refs. Nairobi, 1953.

Observations on the duration of the interval between feeding and oviposition in *Anopheles gambiae* Giles and *A. funestus* Giles were made over a period of 7–8 months in an experimental hut in a village in the coastal region of Tanganyika. The hut had mud walls with a smooth interior finish, a palm-thatch roof and a low ceiling of cotton sheeting. The space between the top of the walls and the eaves was blocked and the windows had close-fitting shutters. Mosquitos could enter through slit shutters below the eaves. Two men slept in the hut and closed the slit shutters just before dawn. All mosquitos that could be found were then caught. Very few unfed females were found inside the hut in the morning and still fewer in window exit traps [*cf. R.A.E.*, B **34** 91]. Fed females were kept in a cage for 24 hours and were then identified to species and released in small separate cages, each with a jar of water in the base and kept until they oviposited. They thus had no opportunity to oviposit on the first night, but the stage of development of the ovaries of dissected females showed that they could not have been ready to do so at any time of the year.

When the temperature exceeded 78°F., the gonotrophic cycle lasted for 48 hours in both species. *A. funestus* had a three-day cycle below 76·5°F., but the cycle still lasted only two days at 74°F. in most females of *A. gambiae*. Oviposition in nature might sometimes be retarded by conditions that inhibited the flight necessary to find a breeding place. The very long interval between feeding and oviposition recorded by Hocking & MacInnes [**37** 60] was probably due to the effect of unnatural conditions. Observations on the ovarian stages of unfed females in catches made in houses and outside resting sites (the results of which are not given in this paper) indicated that most females fed again on the night of oviposition, and it is concluded that *A. gambiae* bites every other night throughout most of the year in the coastal region of Tanganyika, whereas the frequency of biting in *A. funestus* is reduced to every third night during the 5–6 cooler months. In higher and cooler regions of East Africa, a three-day cycle may be more general.

The stages of ovarian development of the females found in the evening in the window traps after a morning collection had been made on the day before but not on the same day indicated that careful hand catching in the hut missed 14 per cent. of the females of *A. funestus* resting in it.

Dobrotworsky (N. V.). **The *Culex pipiens* Group in south-eastern Australia. I.**—*Proc. Linn. Soc. N. S. W.* **77** (1952) pt. 5–6 pp. 357–360, 3 figs. Sydney, 1953.

Dobrotworsky (N. V.) & Drummond (F. H.). **The *Culex pipiens* Group in south-eastern Australia. II.**—*Op. cit.* **78** pt. 3–4 pp. 131–146, 5 figs., 28 refs. 1953.

In south-eastern Australia, mosquitos closely related to *Culex pipiens* L. comprise three forms of the *pipiens* complex [*R.A.E.*, B **40** 66] and an additional member of the *pipiens* group, which is described in the first part of this paper from adults of both sexes, pupa, larva and egg-raft as *C. globocoxitus*, sp. n. This mosquito occurs throughout Victoria, in the neighbouring parts of South Australia and New South Wales and in Tasmania. Larvae are found in swamps, pools in creek beds and drainage

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pits, and they can tolerate very polluted water. The species is homodynamic, anautogenous, and stenogamous (mating in a space as small as 3 cu. ins.), and it does not bite man. Many females were collected in a dwelling but none was freshly engorged, and females fed on human blood in the laboratory laid relatively small egg-rafts. Mating was observed in the laboratory at temperatures as low as 13°C. [55·4°F.], and larvae in various instars and pupae were found in pools in late July and early August 1951, fourth-instar larvae and pupae in early July 1952 and pupae and first-instar larvae in August. It appears, therefore, that one or two generations are completed during the winter.

The three members of the *pipiens* complex are discussed in the second part of the paper. They are *C. pipiens* form *molestus* Forsk., *C. p. fatigans* Wied., and the hitherto undescribed dark form [*loc. cit.*], which is here described from larva, pupa and adults of both sexes as *C. pipiens australicus*, subsp. n. The taxonomic status of these three mosquitos is discussed, and keys are given to the adults of both sexes of these and *C. globocoxitus*. It is considered premature to regard *fatigans* as a subspecies of *pipiens* until the status of the members of the complex with which it interbreeds [**24** 271; **30** 50; **40** 64, etc.] has been clarified.

In its morphology and biology, the Australian *molestus* conforms to the *molestus* of Marshall & Staley [**25** 136]. It is recorded from Victoria and northern Tasmania and was not restricted to urban situations [*cf.* **40** 64] but was common near dwellings in rural areas. It is a troublesome pest in Melbourne, entering houses at night to feed from October until May. It bred throughout the year in the laboratory, and adult emergence and oviposition continued into early July in outdoor cages. Egg-rafts were plentiful until the end of June in the field, and dancing of males was observed in one mild spell when the temperature was 14°C. [57·2°F.]. Attacks on man ceased about the middle of May. Larvae that hatched from eggs laid in outdoor cages in June passed the winter in the third or fourth instar. Most larvae that hatched in July died. Adults began to emerge from these colonies and from exposed natural breeding sites in September, but some sheltered breeding places contained pupae during the winter and emergence from them was complete by the end of August. The larvae are very tolerant of foul water and occurred mainly in artificial containers and drainage pits but were sometimes found in large pools and swamps. *C. p. fatigans* is widely distributed in Australia where it is the common domestic *Culex*, but in southern Victoria it is apparently unable to maintain itself in winter and was found regularly only in late summer and autumn. It hybridised freely with *molestus* in reciprocal crossings and the F_1 hybrids were vigorous and fertile; hybridisation in nature appeared to occur readily at the time of year when *fatigans* was abundant, but no permanent populations of intermediates were found. The Australian hybrids resemble "Alabama *quinquefasciatus*" [**40** 67–68; 187–188].

C. p. australicus is also widely distributed in Australia; it is recorded from Victoria, New South Wales, Queensland, South Australia, Tasmania and Western Australia. In the past, it has been confused with *fatigans*, but it is more closely related to *pipiens*. The males are quite distinct morphologically, and the females can be readily separated from *molestus* and usually from *fatigans* also. Biologically, it is very similar to *C. p. pipiens*. It is a rural mosquito that does not bite man and is anautogenous, eurygamous and heterodynamic. Females were caught in houses but were not freshly engorged, and females fed on human blood in the laboratory laid egg-rafts that were only a third of the size of those found in nature. Chickens and canaries were not attacked in the laboratory, but birds are considered normal hosts, as many adults were caught in a poultry house

containing fowls and ducks, ten that were freshly engorged had avian blood in the gut, and others laid rafts of normal size. D. J. Lee has found that rabbits are also attacked. Breeding continued throughout the summer in Melbourne, but some observations at Mildura suggest that reproduction is interrupted during mid-summer in northern Victoria. The favoured breeding sites were pools, swamps or channels with stationary or slowly moving clean water, but polluted water and artificial containers were occasionally used. *C. p. australicus* had a limited capacity for interbreeding with *fatigans* and *molestus* in the laboratory, but is reproductively isolated from both in nature. Laboratory crosses between female *australicus* and male *molestus* or *fatigans* were sterile, but the reciprocal crosses were fertile.

C. globocoxitus interbred freely in the laboratory with both *molestus* and *fatigans*. The crosses were fully fertile, and the larvae developed normally to give fertile F_1 adults. In crosses with *australicus*, about 80 per cent. of the eggs hatched, but the larvae failed to develop. Crossing between *globocoxitus* and *molestus* occurs occasionally in nature; three males collected in Melbourne were indistinguishable from laboratory hybrids between these forms.

Galindo (P.), Carpenter (S. J.) & Trapido (H.). **The taxonomic Status of the *Aedes leucocelaenus* Complex with Descriptions of two new Forms (Diptera, Culicidae).**—*Ann. ent. Soc. Amer.* **45** (1952) no. 4 pp. 529–542, 21 figs., 8 refs. Columbus, Ohio, 1953.

Aëdes leucocelaenus Dyar & Shann., a vector of sylvan yellow fever in Brazil [*R.A.E.*, B **40** 114, etc.], has been recorded from Panama to Argentina and related forms have also been found within this range. Comparison of material from Costa Rica, Panama and Brazil (Rio de Janeiro, São Paulo and Territorio do Acre, which is on the eastern slopes of the Andes) has led the authors to conclude that *A. leucocelaenus* extends from Costa Rica along the east coast of South America to Argentina and breaks up into two subspecies at the extreme ends of the range. These are *A. l. leucocelaenus* in southern Brazil and Argentina and *A. l. clarki*, subsp. n., in Panama and Costa Rica. *A. l. clarki* is described from adults of both sexes, larva and pupa from Panama, where it had been recorded as an undescribed species and possible vector of yellow fever in an earlier paper [**41** 26]. Intergrading forms were found with the typical one in Rio de Janeiro and presumably occur throughout the rest of the range; Komp has informed the authors that specimens from Trinidad and from Rio de Janeiro studied by him closely resembled the Central American form. The material from Territorio do Acre represented a distinct species, which is described from larva, pupa and adults of both sexes as *A. leucophoebus*, sp. n. It can be separated from *A. leucocelaenus* on characters of larva, pupa and male terminalia.

Another species of the complex, *A. leucotaeniatus* Komp [**27** 140], which occurs in Panama and Costa Rica, is also described. It can be readily distinguished by characters of the larva, pupa, female and male terminalia. A male illustrated by Komp [**27** 140] without reference to its locality of origin corresponds neither to the topotypical males of *A. leucocelaenus* in the authors' collection nor to the new forms described in this paper. Komp states that it was taken in Restrepo, Colombia, and that comparison of males, larvae and pupae from Restrepo with material and figures of the other three forms shows the Colombian one to be a distinct species that will be described by him. Characters distinguishing *A. l. leucocelaenus*, *A. l. clarki*, *A. leucophoebus* and *A. leucotaeniatus* are summarised. It was found that the members of the complex are most easily separated by

characters of the pupa (the shape of the paddle, its terminal hair and hair 2 of segment I).

Dalmat (H. T.) & Gibson (C. L.). **A Study of Flight Range and Longevity of Blackflies (Diptera, Simuliidae) infected with** *Onchocerca volvulus*. —*Ann. ent. Soc. Amer.* **45** (1952) no. 4 pp. 605–612, 1 map, 4 refs. Columbus, Ohio, 1953.

In continued experiments on the flight-range and length of life of Simuliids in Guatemala [*cf. R.A.E.*, B **39** 213; **41** 15], the effect of infection with *Onchocerca volvulus* was studied. During December 1950, 30,748 adults of *S. ochraceum* Wlk., 8,625 of *S. metallicum* Bellardi and 1,101 of *S. callidum* (Dyar & Shann.) that had fed on subjects who had heavy infections of microfilariae of *O. volvulus* and who had demonstrated their ability to infect Simuliids were stained and released on 12 days in the area used for the earlier work. Six different aniline dyes were used, each on two consecutive days. Collections were made at 21 stations on 60 non-consecutive days beginning on the ninth day of staining, and 55,366 adults of *S. ochraceum*, 81,475 of *S. metallicum* and 7,867 of *S. callidum* were taken, of which 15, 23 and four were stained. Only three of the stained flies showed infections. One adult of *S. ochraceum*, which had flown 2·9 miles in 2–3 days, contained about 20 microfilariae in the abdominal blood mass and one in the thoracic muscles. Only the one in the thorax appeared normal. The other two infected individuals (*S. ochraceum* and *S. callidum*) had flown 2·7 miles in 3–4 days and harboured one and two "sausage" forms in the thoracic muscles, respectively.

Although so few infected individuals were recovered, these results show that it might be necessary to extend measures for the control of infected Simuliids at least 2·9 miles beyond an area to be protected. As past experience has indicated that half the adults that take blood from a heavily infected person become infected, it would be expected that, were there no abnormal mortality, infections would have been found in 21 of the 42 recovered. The fact that only three infected ones were recovered, suggests that infection may shorten life in the field as it has been observed to do in the laboratory.

Laird (M.). *Anopheles* **and Malaria at Aneityum, New Hebrides.**—*Bull. ent. Res.* **45** pt. 2 pp. 279–283, 16 refs. London, 1954.

There is evidence that Aneityum, which is the most southerly island of the New Hebrides and lies on 20°12′S. latitude, has been malarious at least since Europeans first settled there. Children infected with *Plasmodium vivax* and *P. malariae* were found in a survey undertaken in 1952, but whereas *P. vivax* was only in two who had visited the island of Tanna, about 40 miles to the north-west, *P. malariae* was in five who had never left Aneityum. The only Anopheline found in mosquito surveys made at the same time was *Anopheles farauti* Lav., all the immature stages of which were abundant, particularly in taro swamps. Larvae were particularly common in irrigation channels, where *Spirogyra* and emergent and marginal vegetation gave protection from direct sunlight and predators. Most of them had the tubercles of the inner and centre shoulder hairs joined to form a single plate, though some had them separate on one side and joined on the other, as noted for this species by Lee & Woodhill [*R.A.E.*, B **33** 193]. Engorged females were collected from bed nets in native huts within a mile of swamps. In the absence of any other species of *Anopheles*, it must be

assumed that *A. farauti* is the vector of *P. malariae* on Aneityum. This is the first demonstration of indigenous quartan malaria from the New Hebrides and of Anophelines or indigenous malaria from a Pacific island south of 20°S. latitude.

Laird (M.). **A Mosquito Survey in New Caledonia and the Belep Islands, with new Locality Records for two Species of** *Culex*.—*Bull. ent. Res.* **45** pt. 2 pp. 285–293, 12 figs., 12 refs. London, 1954.

The following is mainly the author's summary. The mosquito fauna of New Caledonia and the Belep Islands is discussed, together with some features of the larval morphology of *Culex pipiens fatigans* Wied., *C. annulirostris* Skuse and *C. pseudomelanoconia* Theo. *C. bitaeniorhynchus* Giles, which is recorded from New Caledonia for the first time, is probably a post-war introduction into the Noumea area from Australia. *C. fraudatrix* Theo., recorded from Art Island (Belep group), has not previously been known from the New Caledonia area. From the mosquito surveys and a blood-smear survey in the Belep Islands, it is concluded that these islands and New Caledonia are as yet free from *Anopheles* and malaria. As potential breeding places favourable for *A. sundaicus* (Rdnw.) and *A. farauti* Lav. appear to exist in New Caledonia, which has regular air and sea communication with places where these Anophelines occur, the need for comprehensive quarantine measures to prevent their introduction is stressed.

Kerr (R. W.). **Rearing** *Drosophila melanogaster* **Mg. for Insecticide Investigations.**—*Bull. ent. Res.* **45** pt. 2 pp. 313–316, 1 pl., 8 refs. London, 1954. **A Method for the topical Application of small measured Doses of Insecticide Solutions to individual Insects.**—*T.c.* pp. 317–321, 2 pls., 9 refs. **Variation with Age in the Susceptibility to DDT and the Respiration Rate of Male and Female** *Drosophila melanogaster* **Mg.**—*T.c.* pp. 323–328, 1 graph, 13 refs.

In the first of these papers, the author describes a method of rearing *Drosophila melanogaster* Mg. that provides a high and consistent yield of adults of uniform age and size for tests of insecticides, and so eliminates variations in susceptibility due to differences in the age of the test insects and their parents or in the amount of food available during development. Newly emerged adults were confined in batches of about 300 in half-pint milk bottles with sleeves of muslin or nylon closed by means of rubber bands, and the bottles were stored horizontally in a rack. Each bottle contained a waxed cork with a hole in the top to form a well for the food and a tube filled with water and plugged with cotton-wool on which was placed a disk of black filter paper, $\frac{3}{4}$ in. in diameter. The food was a 1 : 1 mixture of honey and compressed bakers' yeast. Newly emerged adults survived in these jars for at least 14 days when the food was changed daily, but died within 48 hours when water tubes were not provided and the relative humidity of the room was 40–50 per cent. Oviposition began after four days, the eggs being laid on the filter paper and round the food well. The papers bearing the eggs were transferred to fresh bottles, in which they were placed, with the eggs downwards, on a food medium of bakers' yeast cultured on a mixture prepared by boiling together rolled oats and aqueous solutions of agar and treacle, with a preservative. Not more than 400 eggs were placed in each jar, and rearing took place at 24°C. [75·2°F.]. The eggs hatched during the first day, pupation took place after 4–5 days in

loosely crumpled cellulose wadding introduced for the purpose, and emergence of the adults, which were removed daily, began on the ninth day and reached a peak 3–4 days later. Flies that had been treated with an insecticide were kept in glass vials (3 × 1 in.) containing cotton-wool moistened with 3 ml. of an aqueous solution of treacle, yeast or both, each at a concentration of 5 per cent. Of the control flies, 100 per cent. survived for over 72 hours when the food was treacle only, and for less than 48 hours when it was yeast or the mixture. This difference is attributed to the toxic effect of the carbon dioxide generated by the growing yeast, since a higher proportion of the flies survived for 48 hours when the jars were stored on their sides so that the carbon dioxide could escape through the cotton-wool plugs. It is stated in a foot-note in the third paper that the strain of flies used (designated Rothamsted wild type) has shown a sensitivity to carbon dioxide previously recorded in only one other *Drosophila* strain.

In the second paper, the author describes a method that was used to apply doses of solution of insecticides of the order of 0·01 mml. to adults of *D. melanogaster*. The following is virtually his summary. A microburette made from glass capillary tubing is mounted on the mechanical stage of a microscope and filled with insecticide solution to a point at which the meniscus is in the field of the microscope. The magnified images of the meniscus and a calibrated micrometer scale in the eyepiece are projected on to a small screen mounted close to the tip of the microburette so that the scale and the insect being dosed can be seen simultaneously. This feature renders the apparatus particularly suitable for topical application work in which accurate positioning of the dose on the insect is required. When an insect, held in a suction device described, is applied to the tip of the burette, the solution flows out unaided, and stops immediately the insect is removed. With the microburette described, doses from 0·005 to 0·035 mml. can be dispensed to within ±0·00035 mml. The apparatus can be made to cover several lower or higher dosage ranges by simple modifications.

The following is based on the author's summary of the third paper, which is an account of experiments in which the methods of rearing the flies and treating them with DDT were those described in the first two. The log-probit dosage-mortality curves for males and females treated with DDT when five days old were parallel, and males were 1·86 times as susceptible as females. Susceptibility was high in young flies, but decreased rapidly with age, to a minimum at about five days, thereafter increasing rapidly in males and not significantly in females. The need for using flies of known sex and standard age in toxicity investigations was thus demonstrated. The rate of respiration in untreated males increased with age up to five days, and then decreased; in females it increased with age up to nine days. Variations with age in respiration rate and susceptibility to DDT were thus negatively correlated.

GILLIES (M. T.). **Studies in House Leaving and Outside Resting of *Anopheles gambiae* Giles and *Anopheles funestus* Giles in East Africa. I. The outside resting Population.**—*Bull. ent. Res.* **45** pt. 2 pp. 361–373, 1 pl., 25 refs. London, 1954. **II. The Exodus from Houses and the house resting Population.**—*T.c.* pp. 375–387, 1 fig., 16 refs.

The studies on *Anopheles gambiae* Giles and *A. funestus* Giles described in these papers were carried out in 1951–52 near Tanga in a low-lying coastal district of Tanganyika [*cf. R.A.E.*, B **42** 113]. The mean monthly temperature at a laboratory in the neighbourhood varied from 73°F. in July to 81·4°F. in March. Rainfall occurs mainly in April–May and October–December, so that there is a long cool dry season from June to September

and a shorter hot one from January to March. The outdoor resting populations were studied by collecting the mosquitos from natural resting sites and from artificial box shelters sunk flush with the soil surface in shaded banks [*cf.* **22** 65]. The box consisted of a wooden frame over which plastic gauze was stretched, and the open end was partly covered by a dark curtain. The natural resting places were all shaded by trees or bushes and included depressions at the base of tree trunks and the undersides of rocks and overhanging banks. Females caught were classified as unfed (virgin females with Stage I ovaries [**29** 93; **37** 60], or unfed multiparous females with Stage II ovaries), fed (having ovaries in Stages II and III and fresh blood) or gravid (having ovaries in Stages II, IV or V and partly or completely digested blood).

The catches made in box shelters in April–August 1951, October–December 1951 and April–July 1952 were essentially similar in composition, and a small catch of *A. gambiae* made in natural resting places did not differ materially from the catches in boxes. The catches of *A. funestus* in natural sites, made mainly in the hot season when the outside population is lowest, indicated a higher proportion of unfed females than catches from box shelters. The percentages of the total catch that were unfed, fed and gravid were 32·7, 7·5 and 59·8 in *A. gambiae* and 42·4, 6·9 and 50·7 in *A. funestus*. The ratios of fed to gravid females of *A. gambiae* less and more than 200 yards from houses were 1 : 4·6 and 1 : 12·5, respectively, and of *A. funestus*, 1 : 5·3 and 1 : 37·3. Under coastal conditions in Tanganyika, fed and gravid females of *A. gambiae* are those in the first and second days, respectively, of the gonotrophic cycle, as this lasts two days in all [**42** 113]. The catches thus indicate that females seldom leave houses immediately after feeding but may rest outside in the second half of the cycle. In *A. funestus*, which has a gonotrophic cycle lasting three days in cold weather [**42** 113], the proportion of gravid females taken in the shelters distant from houses rose in the cool season as would be expected. The rise was very slight in shelters near houses, and suggested that such shelters reflect the house-resting population.

Precipitin tests on the small numbers of fed females caught outside were nearly all positive for human blood. The identification of gravid females of *A. funestus* was confirmed by periodic examination of the eggs [*cf.* **22** 211; **25** 106]. Females did not enter outside shelters solely in the period around sunrise. An appreciable number of females of *A. funestus* entered after 7 a.m., particularly in shaded shelters. Outside biting activity was negligible as a source of females of either species resting outside. It is concluded that in the low-lying coastal belt of East Africa, outside resting occurs in both species during the second or third day of the gonotrophic cycle. The work of Hocking & MacInnes [**37** 60] is discussed, and their findings are deemed to be in accord with the observations recorded in this paper. Their conclusion that the females rest outside only immediately before or after oviposition is considered misleading.

The observations on exodus from houses after feeding were made in two specially designed mud huts with thatched roofs and exit traps [**42** 113]. The trap catches indicated that only about 4–8 per cent. of both species left during the night in which they fed or the following morning, and about half of these were newly emerged. Only 3·1 per cent. of the half-gravid females of *A. funestus* left at dusk, 12–24 hours after entering for a blood-meal, but 43 per cent. of the half-gravid females of *A. gambiae* did so.

Among females of *A. gambiae* collected during daytime in ordinary African houses, the percentages that were unfed, fed and gravid were 4·3, 65 and 30·7 in the hot season and 3·6, 56·5 and 39·9 in the cool season; the corresponding percentages for *A. funestus* were 13·7, 50·9 and 35·4 in

the hot season and 5·9, 45·4 and 48·7 in the cool season. It thus appears that *A. funestus* makes rather less use of outside shelters than *A. gambiae* during the hot months. The high proportion of gravid females of *A. funestus* in the cool season is attributed to its prolonged gonotrophic cycle at this time. Considerably more gravid than fed females of *A. funestus* were found in a house of a particularly open type. This must be due to re-entry, probably at dawn, of females that had left other houses. Probably, the degree of light inside a house is unimportant in the case of re-entry at dawn, as compared with the number of openings available to females seeking shelter. No mortality was detected among females of *A. funestus* resting under natural conditions for 24 hours in an experimental hut. Analysis of ovarian development in unfed females of both species showed that most feed every other night when the gonotrophic cycle lasts two days and every three nights when the cycle lasts three days.

CHARLES (L. J.). **Toxicity of the botanical Insecticide** *Ryania speciosa* **to** *Culex pipiens fatigans* **Wied.**—*Bull. ent. Res.* **45** pt. 2 pp. 403–410, 9 refs. London, 1954.

The following is based on the author's summary. In the course of general studies on the control of *Culex pipiens fatigans* Wied. in British Guiana, aqueous extracts of the dried stems of the indigenous shrub, *Ryania speciosa*, were shown to be toxic to the larvae under clean laboratory conditions. Under conditions simulating a water-logged pit latrine, however, toxicity was greatly reduced by adsorption of the active agent, ryanodine [*cf. R.A.E.*, A **39** 209], rendering the crude stem relatively ineffective after 16 days. Because of the great bulk of unprocessed material required for even this limited result in pit latrines, which constitute an important local source of the mosquito, *Ryania* was not considered of practical value in its control.

Deposits from aqueous and alcoholic extracts of *Ryania speciosa* had no contact insecticidal properties against adults of this mosquito.

CHARLES (L. J.). **Malaria in the Leeward and Windward Islands, British West Indies.**—*Amer. J. trop. Med. Hyg.* **1** no. 6 pp. 941–961, 7 figs., 25 refs. Baltimore, Md., 1952.

The British islands of the Leeward and Windward groups, their climate and population are briefly described, malaria morbidity and mortality rates for the years 1933–42 are shown, and an account is given of a malaria survey of them made during 1943–47. Over 20,000 children were examined for splenic enlargement and 6,472 for malaria parasites on eight islands, and the spleen rates (and parasite rates) found were 9·1 (8·7) in Grenada, 0·7 (0·0) in St. Vincent, 11·3 (12·9) in St. Lucia, 9·8 (10·4) in Dominica, 0·0 (0·0) in Montserrat, 5·6 (7·8) in Antigua, 1·9 (1·9) in Nevis and 2·3 (2·2) in St. Kitts. In Grenada, St. Lucia, Dominica and Antigua, high rates were found in scattered areas. Localised outbreaks of malaria appeared to occur periodically in each island. *Plasmodium falciparum* predominated, *P. malariae* was common and *P. vivax* infrequent. The species of *Anopheles* found were *A. aquasalis* Curry in all the islands, *A. argyritarsis* R.-D. in Grenada, St. Vincent, St. Lucia, Dominica and Antigua, *A. albimanus* Wied. in Montserrat, Antigua and Nevis and *A. pseudopunctipennis* Theo. in Grenada. From the epidemiological data, it appeared that both *A. aquasalis* and *A. albimanus* were transmitting malaria. The use of DDT deposit sprays in major endemic foci is advocated.

Mansonella ozzardi was found in the blood of 0·6–3·2 per cent. of the children examined in Antigua, Nevis, St. Vincent, Dominica and St. Lucia. In Dominica, where it occurred in 2·9 per cent. of all blood smears, it was limited to seven localities on the west coast, and 13·3 per cent. of 120 children were infected in one place, well known for periodic infestation by *Culicoides furens* (Poey).

Schwab (M.), Allen (R.) & Sulkin (S. E.). **The Tropical Rat Mite (*Liponyssus bacoti*) as an experimental Vector of Coxsackie Virus.**—*Amer. J. trop. Med. Hyg.* **1** no. 6 pp. 982–986, 2 figs., 11 refs. Baltimore, Md., 1952.

As neutralising antibodies for viruses of the Coxsackie group [*R.A.E.*, B **41** 86] have been found in the sera of various wild rodents and as *Bdellonyssus* (*Liponyssus*) *bacoti* (Hirst) had infested animals and workers in the authors' laboratory in Texas where investigations on viruses of this group were in progress, experiments were carried out to determine whether the mites could transmit them. Attempts to isolate Coxsackie virus from mites collected from the laboratory woodwork and from a nest of wild mice failed. Mites that had received a blood-meal on white mice infected with the Dallas M.B. strain were shown by inoculation to harbour infection for as long as 16 days, but of 36 suckling mice exposed to the bites of infected mites during this period, only one, bitten on the third day, developed infection. It is possible that this mouse was infected by ingesting a mite and not by being bitten by one. Four other mice bitten on the same day failed to show evidence of even latent infection. However, subsequent attempts to infect mice by administering a virus-containing mite suspension orally and intranasally or by feeding them on whole infected mites were unsuccessful, although it has been shown that suckling mice can be infected by oral administration of the virus. Limited tests with progeny from the infected mites failed to indicate the occurrence of transovarian passage of the virus. It is concluded that *B. bacoti* could play only a small part, if any, in the transmission of the strain of Coxsackie virus tested.

Jung (R. C.) & Shaffer (M. F.). **Survival of ingested *Salmonella* in the Cockroach *Periplaneta americana*.**—*Amer. J. trop. Med. Hyg.* **1** no. 6 pp. 990–998, 19 refs. Baltimore, Md., 1952.

The following is substantially the authors' summary. Faeces from healthy human donors were inoculated with *Salmonella typhimurium* (two strains) or *S. montevideo* (two strains), and the survival of the organisms during storage in closed containers at 15–25°C. [59–77°F.] was determined. An appreciable proportion of the number introduced could be recovered in all trials after two days, frequently after 5–7 days, sometimes even after 14 days. Adults of *Periplaneta americana* (L.) that had been starved for a week were allowed to feed on uninfected human faeces. The quantity ingested in a single meal was estimated to be about 0·02–0·1 gm. Similarly starved adults of the same species were allowed to feed on human faeces to which varying numbers of *Salmonella* had recently been added. The alimentary tracts were removed after an interval of two or seven days and cultured for the presence of the organisms. Survival in the gut was demonstrated to occur fairly regularly and to persist for at least seven days when the cockroaches had ingested about 10,000 or more viable organisms in the case of one of the strains of *S. typhimurium* or one of *S. montevideo*.

With smaller doses, recovery of the *Salmonella* was obtained only rarely. Limited data obtained with the other strain of *S. montevideo* suggested that it had somewhat less ability to persist. Although *P. americana* appears to have some mechanism for eliminating many hundreds of the ingested organisms, an individual that eats faeces containing several thousands of them may thus harbour certain strains for at least a week.

MAIER (P. P.), BAKER (W. C.), BOGUE (M. D.), KILPATRICK (J. W.) & QUARTERMAN (K. D.). **Field Studies on the resting Habits of Flies in Relation to chemical Control. Part I. In urban Areas.**—*Amer. J. trop. Med. Hyg.* **1** no. 6 pp. 1020–1025, 1 ref. Baltimore, Md., 1952.

The following is based on the authors' summary. Diurnal and nocturnal observations of the resting habits of flies in urban areas were made in the neighbourhood of Pharr, Texas, from January 1950 to June 1951 and in Savannah, Georgia, during a short period in the summer of 1950. *Musca domestica* L. was the most numerous species at Pharr, followed in order of abundance by *Sarcophagula occidua* (F.), *Drosophila* spp. (*repleta* Woll. and *melanogaster* Mg.) and *Lucilia* (*Phaenicia*) spp., chiefly *L. cuprina cuprina* (Wied.) (*pallescens* Shann.) and *L. sericata* (Mg.). In Savannah, *L. cuprina cuprina* was by far the most numerous, with *M. domestica* second and *Sarcophaga* sp. third. In both areas, scattered garbage and soil on which dish water, table scraps and other material attractive to flies had been thrown were the principal daytime resting surfaces, and grasses, weeds, trees and shrubs the most important nocturnal resting surfaces for all observed species except *Drosophila*. Most of the flies of the genus *Drosophila* found were in privy pits by day and on privy ceilings at night.

On the basis of these studies, it appears that spraying to leave toxic deposits for the control of flies in urban areas should include the treatment of grasses, weeds, shrubs, the lower limbs of trees, the interior of privies, and garbage bins and their immediate environs. In the Pharr area, the interior of certain small unscreened buildings peculiar to the locality should also be treated. The spraying of outbuildings or the outsides of any structures was not indicated. The high concentration of flies in preferred nocturnal resting places suggests that selective space spraying of these resting places at night might give more efficient control than daytime space spraying according to present procedure. The presence of great numbers of *Drosophila* in privies suggests the need for further studies to determine their status in relation to the dissemination of disease organisms.

KILPATRICK (J. W.) & QUARTERMAN (K. D.). **Field Studies on the resting Habits of Flies in Relation to chemical Control. Part II. In rural Areas.**—*Amer. J. trop. Med. Hyg.* **1** no. 6 pp. 1026–1031, 1 ref. Baltimore, Md., 1952.

The following is based on the authors' summary. *Musca domestica* L. comprised 97 per cent. of the flies observed in studies of resting habits of flies in rural areas near Savannah, Georgia, in 1950–51. Of the flies found resting by day on premises with screened and unscreened dwellings, only about 12 and 21 per cent. were on surfaces that are normally sprayed. The greatest concentrations of flies in unscreened houses during the day were in the kitchens. Repeated all-night observations showed that flies remained in one place throughout the night. Screens appeared to be more than 97 per cent. effective in preventing flies from entering homes. On premises where

the houses were unscreened, about 90 per cent. of the flies found resting at night throughout the year were in the houses. On premises where the houses were screened, flies rested at night in barns when the weather was cool, began to move out to porches at slightly higher temperatures, and rested mainly on the lower branches of trees and on shrubs as minimum temperatures approached 70°F. Applications of deposit sprays for the control of flies on rural premises should include the treatment of porches, the lower parts of trees and shrubs adjacent to houses and animal shelters, the interiors of barns, and the ceilings and upper parts of the walls of unscreened dwellings. The high concentrations of flies at night in relatively small areas suggest the possibility of effecting control economically by the selective application of space sprays at night.

QUARTERMAN (K. D.) & MATHIS (W.). **Field Studies on the Use of Insecticides to control Fly Breeding in Garbage Cans.**—*Amer. J. trop. Med. Hyg.* **1** no. 6 pp. 1032–1037, 2 refs. Baltimore, Md., 1952.

Technical BHC (12 per cent. γ isomer), γ BHC as lindane, dieldrin and chlordane were applied in water emulsion at 200, 50, 25 and 50, and 100 and 200 mg. per sq. ft., respectively, to the insides and outsides of garbage bins for the control of flies breeding in them at Savannah, Georgia [*cf. R.A.E.*, B **40** 165], in 1950. Larvae were present in the sludge at the bottom of the containers at the time of treatment. *Musca domestica* L. was the predominant species. The best results were obtained with technical BHC, which allowed the emergence of only 14 adults of *Hermetia illucens* (L.) from 13 bins, and the poorest with chlordane, which at 200 mg. allowed 1,406 adults of *M. domestica*, 20 of *H. illucens* and four of other species to emerge from 16 bins. In tests in 1951, p-dichlorobenzene, applied by distributing the crystals over the bottom sludge at 2 oz. per bin, was more effective than technical BHC applied as in 1950. This was attributed to increasing resistance in *M. domestica* to BHC and other chlorinated hydrocarbons. Neither material controlled breeding for more than two weeks. All treatments appeared effective against blowflies.

Several common species of flies, including *M. domestica*, emerged sporadically from garbage bins throughout the winter of 1950–51. During this time, there were numerous cold spells with minimum temperatures as low as 15°F. Emergence often occurred on days when the minimum temperatures were well below freezing.

BERAN (F.). **Ein Beitrag zur Methodik der Insektizidprüfungen.** [A Contribution to the Method of testing Insecticides.]—*Pflanzenschutzberichte* **11** pt. 9–12 pp. 151–160, 2 figs., 6 refs. Vienna, 1953. (With a Summary in English.)

Musca domestica L. is frequently used as a test insect for the evaluation of contact insecticides, but comparison of the results obtained by different workers is difficult because of the diverse methods adopted. The two principal methods are exposure to a deposit, for a given period or until a given effect is produced, and topical application. A technique is described for the latter in which graduated series of concentrations are used and the flies are treated with 1-mml. droplets and then kept in perforated cellophane bags containing cotton-wool soaked in sugar solution. The bags are used once only, so that cleaning of containers is eliminated. The deposit method

is the more usual and has sometimes been used for quantitative determinations, but these are valid only if an equal amount of toxicant is taken up by each insect. This was shown not to be the case in experiments in which batches of 25 female flies were placed in petri dishes containing deposits from a solution of 10 per cent. DDT in ether and others received for comparison topical applications of 0·4 mg. DDT in acetone. Mortality was complete in both series after 24 hours, and acetone extracts from the flies were tested on further flies. The resulting mortality percentages averaged 7–13 for the first series and 30–36 for the second. The difference in the first case was not significant, but it is too great for quantitative determination and would be even greater for batches containing both sexes, since topical application of 0·472 mmg. per fly to individuals averaging 12·2 mg. in weight caused 60 and 37 per cent. mortality of males and females. respectively. Further, mortality varies with the weight of the flies, topical applications of 1·062 mmg. per female resulting in 56, 64 and 86 per cent. mortality of flies with average weights of 15, 12 and 9·6 mg., respectively. Although these differences were considerable, the products of average weight and mortality percentage (840, 768 and 826) were remarkably constant, and the mortality can therefore be standardised to refer to a uniform average weight. When the results of the last test were transformed in this way for a fly weight of 12 mg., the mortality percentages were 70, 64 and 68, or an average of 67·3, as compared with the experimental average of 68·7. In tests with topical applications of 0·008 mmg. lindane [almost pure γ BHC], the similarly transformed percentages were 52 and 53·2 for flies weighing 250–280 and 190–210 mg. per batch of 25.

The results of tests of insecticides are best analysed by the construction of log-probit dosage-mortality curves that allow determination of the median lethal dose or that giving any other desired level of mortality. The method of doing this is illustrated from tests with DDT, and curves based on experiments with house-flies are given for aldrin, lindane, dieldrin, parathion, toxaphene and DDT, for which the median lethal doses in mmg. per gm. fly weight were 0·42, 0·73, 1·1, 1·56, 19·2 and 55, respectively.

Burchfield (H. P.), Redder (A. M.), Storrs (E. E.) & Hilchey (J. D.). **Improved Methods for rearing Larvae of *Aedes aegypti* (L.) for Use in Insecticide Bioassay.**—*Contr. Boyce Thompson Inst.* **17** no. 5 pp. 317–331, 3 graphs, 6 refs. Yonkers, N.Y., 1953.

Since the advantages of a recently described method for the bioassay of organic insecticides, based on their ability to inhibit the phototactic response of larvae of *Aëdes aegypti* (L.) [*R.A.E.*, A **42** 76], may be nullified by variations in the vitality of the larvae, several factors that affect their resistance in the photomigration test were investigated, and an improved method of rearing [*cf.* B **34** 24] was developed. The resistance of the larvae was measured by the time required by a carbitol-water suspension of heptachlor or chlordane to inhibit the phototactic reaction in 50 per cent. of them (T 50). The insecticides were dissolved in the carbitol (2-(2-ethoxyethoxy)ethanol) at concentrations so adjusted that the required amounts in the suspensions were obtained by mixing 1 ml. solution with 99 ml. water containing 100 larvae.

The main factors concerned in resistance were the age, instar and environment of the test larvae. Tests in which the larvae were exposed to 0·1 part per million heptachlor immediately or at intervals after hatching showed that resistance was very high initially, but dropped rapidly during the first 12 hours, after which it increased gradually until the first moult. It

dropped suddenly after this and each subsequent moult, but increased progressively during each instar and exceeded the initial resistance after 76 hours, in the fourth instar. The best time for testing is immediately after a moult, when resistance is low and the larvae can be maintained in distilled water for a considerable time without moulting, but moulting should be complete throughout the test batch or larvae of the earlier instar removed, to avoid mixed populations of individuals with different degrees of resistance. It is therefore desirable to adjust conditions so that moulting will occur at a predetermined time. Under the rearing conditions of the test, the second instar lasted about eight hours and the third 24, but T 50 was much shorter in the former, the use of which thus accelerated testing and increased sensitivity; this is important for chemicals that act slowly and are therefore difficult to detect at concentrations below 0·1 p.p.m. The use of second-instar larvae also reduces the time required for rearing and the risk of toxic effects due to spoilage of the nutrient. The most convenient rearing time for obtaining large batches of larvae suitable for a complete day's testing proved to be 22 hours, and this was adopted for general use. Even under the best environmental conditions, the yield of second-instar larvae in 22–24 hours was variable, but maintaining the newly-hatched larvae for 18·5 hours in distilled water before the introduction of the nutrient resulted in more uniform moulting.

Apart from differences in growth rate, the chief source of error in the T 50 tests was that some populations floated on the test medium and these responded irregularly to insecticides. Floating was, however, virtually eliminated by the addition of small quantities of Pluronic F-68 (a polyethylene-polypropylene glycol) to the rearing and test media.

In the method of rearing finally adopted, the caged adults were fed daily on 1 per cent. dextrose solution, offered blood-meals on guineapigs for one hour a day and supplied with moist filter-paper for oviposition. The eggs were collected every 24 hours, washed and stored on moist filter-paper in a closed container for five days, and then air-dried for more permanent storage. Hatching was stimulated by immersion for 15–30 minutes in a solution containing 1 per cent. dextrose and 0·15 per cent. U.S.P. XIV salt mixture, and larvae intended for the tests were transferred in batches of 2,000 to 12-litre flasks containing eight litres of water in which 10 p.p.m. Pluronic F-68 had been dissolved. The flasks were stoppered with cotton and kept in a water bath at 29·5°C. [85·1°F.]. After 18·5 hours, 250 ml. water containing 0·25 per cent. of a mixture of brewers' yeast, blood albumin and sucrose (5 : 3 : 2) was added, and the larvae were incubated for a further 22 hours. If most were then in the second instar, they were filtered out of the nutrient without exposure to the air, washed in 10 p.p.m. Pluronic F-68 and kept in batches of 100 in water containing enough of the wash solution to give a concentration of 1 p.p.m. when the test was made. If many first-instar larvae were present after 22 hours' incubation with food, they were incubated for a further hour or two to permit additional moulting.

Tests in which second-instar larvae were exposed to chlordane at 0·5 p.p.m. or to heptachlor at 0·01–0·2 p.p.m. at intervals after removal from the nutrient solution showed that T 50 increased linearly during the first eight hours and that it was necessary to subtract 0·7 minute for each hour after removal to obtain a standard value from the observed one. Tests made at intervals in the course of the work showed that the standard deviation in T 50 between batches was reduced from 4·21 to 1·58 minutes (about 62·5 per cent.) by the improvements in technique developed.

Further causes of variability may include the type and degree of bacterial contamination of the rearing medium, and variations in the average age and viability of the adults from which the eggs are obtained; there was

evidence that larval viability undergoes periodic changes, and this may be related to conditions in the adult colonies.

Williams (R. W.). **The Growth Stimulating Effect of APF, Terramycin Hydrochloride, Vitamin B_{12} and an undetermined Factor " X " upon** *Aedes aegypti* **(L.) (Diptera, Culicidae).**—*Amer. J. trop. Med. Hyg.* **2** no. 1 pp. 109–114, 14 refs. Baltimore, Md., 1953.

For many investigations in which insects have to be dissected, it is desirable to obtain specimens that are as large as the genetic range of the species allows and to rear them in the shortest possible time. With this in view, examinations were made of the effects of various diets on the growth of larvae of *Aëdes aegypti* (L.). The larvae were reared in batches of 100 in pans measuring 10 × 8 ins. and containing a litre of distilled water, and the average size of ten fourth-instar larvae from each pan was estimated by measuring the distance from the anterior margin of the thorax to the base of the siphon. Rearing was carried out at the usual temperature of 27°C. [80·6°F.], as raising the temperature to 37°C. [98·6°F.] increased mortality without accelerating development. The control diet was a well-balanced ground mouse-food, supplied at the rate of 175 mg. per pan daily, and the other foods tested were liver, brewers' yeast, APF (Animal Protein Factor, " Bi-Con 3 " with vitamin B_{12}, streptomycin and terramycin), terramycin hydrochloride and crystalline vitamin B_{12}. The foods were tested separately and in 176 combinations. The control diet produced larvae that compared favourably in size with the largest recorded in nature and were a little, but not significantly, larger than those fed on APF, yeast or liver. All larvae fed only on terramycin hydrochloride or vitamin B_{12} died. The best of the experimental diets was a daily supply of 175 mg. of equal parts by weight of the mouse-food and APF with the addition of 2·5 mg. terramycin hydrochloride and 1·5 mmg. vitamin B_{12}. On the average, larvae reared on it were nearly 4 per cent. larger than those fed on the control diet. They spent 0·2 day longer in the larval stage than the controls, but both pupated and gave rise to adults within five and seven days of hatching.

The larvae receiving a given food were significantly larger in some tests of a series than in others, whereas the differences in size between larvae receiving different foods were similar from test to test. This indicated that there was some unknown and uncontrolled factor (referred to as " X ") that was as influential in determining size as the food. When X favoured maximum growth, it produced an increase in size over the average size of the controls of almost 10 per cent. It is concluded that though it was shown to be possible to rear larvae of *A. aegypti* that are significantly larger than those found in nature or those obtained on a well-balanced diet, the average maximum size, as controlled genetically, was not attained. It might be reached if the factor X were determined, but it might also be necessary to use some other antibiotic or some substitute for vitamin B_{12}.

Pittendrigh (C. S.). **The Ecoclimatic Divergence of** *Anopheles bellator* **and** *A. homunculus*.—*Evolution* **4** no. 1 pp. 43–63, 10 figs., 18 refs. Lancaster, Pa., 1950. **The Ecotopic Specialization of** *Anopheles homunculus*; **and its Relation to Competition with** *A. bellator*.—*T.c.* pp. 64–78, 3 figs., 19 refs.

It is stated in the first paper that transmission of malaria in the part of central Trinidad in which the disease is endemic is due to two closely-related

forest mosquitos, *Anopheles bellator* D. & K. and *A. homunculus* Komp [*R.A.E.*, B **37** 42], both of which breed exclusively in the interfoliar niches of water in bromeliads and have a fairly wide total distribution centred in the wet north-eastern part of the island. The disease is transmitted where the climatic requirements of both the bromeliads and the mosquitos are met in cacao plantations adjoining villages [*loc. cit.*]. Trinidad has been divided into seven zones, designated A–G, with annual rainfalls of over 250, about 200, about 125, 90–110, 70–90, 50–70 and less than 50 ins., respectively. The two Anophelines co-exist over most of their range, which does not include zone A or zone G, but *A. homunculus* is most abundant in zone B, occurs in decreasing numbers in zones C and D and is absent in the drier zones, whereas *A. bellator* is almost absent from zone B, increases in abundance in zones C and D and then becomes less abundant again in zones E and F. The way in which this difference in humidity requirement was reflected in adaptation to microclimate was studied. It was found by catches on platforms with human bait that mosquito activity decreased as the relative humidity fell in the morning. Correlation with humidity was much closer than with temperature. The site of activity of both species also moved downwards into the more humid levels of the forest in the morning and rose to the highest parts of the canopy as humidity rose in the evening. However, *A. homunculus* decreased in density before *A. bellator* in the morning and increased later in the evening, and occurred at lower levels than *A. bellator* at all times except in the evening, when the gradient of microclimate within the forest is eliminated. The ratio of *A. homunculus* to *A. bellator* was lower in the dry, open vegetation of the cacao plantation than in forest, particularly during the times of day when humidity was low.

The reduction in mosquito density with declining rainfall was not associated with a diminution of bromeliad flora. A study of breeding at different levels showed that the differences in feeding activity held for breeding also. In zone C, *A. bellator* had access to the whole bromeliad flora and the level of its maximum breeding activity coincided with the heaviest natural growths, whereas *A. homunculus* was restricted to levels that supported only a sparse population of the small shade-tolerant species of bromeliads, which do not hold much water. The limiting factor for the large bromeliads is light. The numerical superiority of *A. bellator* in zone C is attributed to this. In zone B, where the microclimatic niches of the large bromeliads are very humid, *A. homunculus* is 12–27 times as plentiful as *A. bellator*, presumably because it can use them fully. It is therefore necessary to distinguish in a given area between apparent and actually available breeding ground.

The ecological basis of the vector status of the two Anophelines and the geographic distribution of malaria form the subject of an appendix. It is inferred that in very wet areas, humidity rates are high enough to allow *A. homunculus* to enter the fully illuminated plantations where large bromeliads are abundant and to transmit malaria in and around the houses in the plantations. In drier zones, *A. homunculus* retreats from the plantations and down the forest profile, but *A. bellator* is abundant in the canopy and in plantations and is the vector. The fall in abundance of *A. bellator* from zone C to zone E is parallelled by falling malaria rates. In zone F, *A. bellator* has retreated out of the cacao plantations as *A. homunculus* had done in areas of higher rainfalls and transmission ceases though other factors remain unaltered.

The ecological relations of the two Anophelines in the area where they exist together are discussed in the second paper. It is concluded that the divergence between their humidity requirements is not adequate to account

for the extensive overlap of their distribution, unless some additional divergence eliminates competition for the main breeding places provided by the forest-canopy population of large bromeliad species. Field and laboratory investigations on its nature are described. The field observations, made in zone B and the wetter parts of zone C, immediately showed that *A. homunculus* bred much more than *A. bellator* in the small bromeliads, which are not limited to the upper canopy as the large ones are. Experiments were then made that demonstrated that either discriminating action or differential survival was involved and not merely coincidence of distribution. Breeding indices [**41** 16] for small species on the ground were much higher for *A. homunculus* than for *A. bellator*, and when only a small species was exposed on platforms in circumstances in which mixtures of large and small had produced ratios of *A. homunculus* to *A. bellator* much below unity, the ratios were above unity both in forest and plantation. The factor that the species used by *A. homunculus* more than by *A. bellator* have in common is small water surface and confined space above it. The interspecific difference in vertical distribution of the mosquitos was much more strongly marked in breeding than in feeding activity. The difference in breeding in small bromeliads is thought to be due to selective oviposition rather than differential survival, but no critical or conclusive evidence is available.

It is suggested that these observations and others, recorded by Bates [**38** 19], of the occurrence in a forest area in Colombia of four species of *Wyeomyia*, each breeding in water held by a different type of plant, offer a difficulty for the hypothesis that adaptive divergence permitting the overlap of sibling species is wholly of allopatric origin. The difficulty consists of the failure to detect any geographical segregation of selection pressures (ecological conditions) that would account for the interspecific divergence. A segregation is, however, immediately obvious in the area of sympatry. It is possible that adaptive divergence may arise sympatrically after allopatric speciation and secondary overlap, if the overlap area is isolated as it is in Trinidad.

Arthur (D. R.). **The Host Relationships of *Ixodes hexagonus* Leach in Britain.**—*Parasitology* **43** no. 3–4 pp. 227–238, 3 figs., 42 refs. London, 1953.

The following is substantially the author's summary. On the basis of data collected in south Wales and south-eastern England mainly in 1949–51, *Ixodes hexagonus* Leach appears to have spring and autumn peaks of activity on hedgehogs, stoats and weasels. One or more stages are recorded on 15 mammalian hosts, and all stages on hedgehogs, stoats, foxes, polecats and ferrets. The weasel is probably the smallest habitual host. No satisfactory evidence of the occurrence of *I. hexagonus* on birds was obtained.

Man is an accidental host, and records of *I. hexagonus* on man in the London area are given. It seems that ill-effects following its bite are rare. In built-up areas, the probable sources of infestation are dogs, cats and hedgehogs. Air-raid shelters and similar constructions that have harboured these hosts at some time may provide a centre of infestation of man. The number of ticks in most hedgehogs' nests did not appear to be large. Nothing is known of the tick population in the habitats of other hosts. It is suggested tentatively that the ticks may drop off hedgehogs away from the nest and they or their progeny subsequently be picked up by such animals as foxes, stoats or weasels. The records of the tick in Britain are summarised. They indicate that it is a southern species, though the evidence is far from conclusive.

Griffiths (R. B.) & Gordon (R. M.). **An Apparatus which enables the Process of Feeding by Mosquitoes to be observed in the Tissues of a live Rodent; together with an Account of the Ejection of Saliva and its Significance in Malaria.**—*Ann. trop. Med. Parasit.* **46** no. 4 pp. 311–319, 3 pls., 3 figs., 12 refs. Liverpool, 1952.

An apparatus is described with the aid of which direct observations, moving-picture records and still photographs were made of the mouth-parts of females of *Aëdes aegypti* (L.) while they were feeding on the ears of anaesthetised white mice. The results of observations are given, supplemented by some on sections cut through the tissues of animals in which the proboscis of the feeding mosquito had been snipped off. The behaviour of the fascicle in mammalian tissue did not differ in any essential respect from that observed when the mosquito fed on the transparent membrane of frog-web [*R.A.E.*, B **28** 123]. Certain features readily observable in the frog-web were only occasionally detected in the denser mammalian tissue, but the ejection of the salivary secretion was much more easily seen in the mouse's ear than in the frog-web, and occurred every time the fascicle was kept in view for more than a few minutes. The mosquito injected salivary secretion at short intervals during the whole process of probing the tissues, and probably continues to do so after the blood-supply is tapped. The dissemination of malaria sporozoites by an infective mosquito feeding on a mammal is discussed in the light of the observations, and it is concluded that sporozoites may be distributed throughout the entire area that can be reached by the fully extended fascicle. The fate of sporozoites injected into the tissues, as distinct from the blood-stream, is not known, but it is suggested that they may eventually reach the liver and invade the parenchymatous cells.

Unsworth (K.). **The Ixodid Parasites of Cattle in Nigeria, with particular Reference to the Northern Territories.**—*Ann. trop. Med. Parasit.* **46** no. 4 pp. 331–336, 1 map, 10 refs. Liverpool, 1952.

Examination of more than 60,000 Ixodids taken on cattle in monthly collections made over a period of a year in Nigeria, mainly in the cattle-rearing areas of the north, showed them to belong to 16 species, one of which was represented by two varieties. A list of these ticks is given, with notes on their distribution and prevalence.

Addison (C. C.) & Furmidge (C. G. L.). **Physicochemical Studies on the Application of Insecticides to Sheep Fleece. IV. The Influence of physical Properties of Fleece on the Inactivation of cationic Wetting Agents.**—*J. Sci. Fd Agric.* **5** no. 3 pp. 139–145, 3 graphs, 4 refs. London, 1954.

The results are given of investigations of the physical properties of samples of fleece from Scotch Blackface sheep of ages ranging from one to five years. These properties include grease and suint contents, pH, surface area and inactivation of cetylpyridinium chloride. It is concluded that the general principles governing inactivation of solutions of cationic wetting agents outlined in the third paper of this series [*R.A.E.*, B **41** 129] are applicable to any type of Scotch Blackface sheep, but that a quantitative treatment of inactivation must take account of the surface area of the fleece, as well as the grease and suint contents of the wool.

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Mitlin (N.), Gersdorff (W. A.) & Nelson (R. H.). **Strobane—relative Toxicity against House Flies.**—*Soap & sanit. Chem.* **30** no. 3 pp. 157, 189, 2 refs. New York, N.Y., 1954.

The toxicity to *Musca domestica* L. of a new commercial chlorinated mixture of α-pinene isomers (Strobane) was compared with that of toxaphene and of pyrethrins in tests by the turntable method [*R.A.E.*, B **26** 246]. The Strobane and toxaphene contained 65 and 67·6 per cent. chlorine, respectively, and the pyrethrins contained 52 per cent. pyrethrin I and cinerin I. Knockdown in 25 minutes was negligible with the two chlorinated compounds and complete with pyrethrins. The concentrations in mg. per ml. required for 50 per cent. mortality were 1·46 for Strobane, 1·15 for toxaphene and 1·86 for pyrethrins, giving relative toxicities of 0·79, 1 and 0·62. Strobane was 1·96, 1·27 and 1·21 times as toxic as pyrethrins at the concentrations required for 90, 50 and 10 per cent. mortality, respectively.

Mooser (H.) & Weyer (F.). **Künstliche Infektion von Läusen mit *Borrelia duttoni*.** [The artificial Infection of Lice with *Spirochaeta duttoni*.]—*Z. Tropenmed. u. Parasit.* **5** pt. 1 pp. 28–45, 6 figs., refs. Stuttgart, 1954. (With a Summary in English.)

The following is based on the authors' summary. *Pediculus humanus humanus* L. (*P. vestimenti* Nitzsch) was infected with three strains of *Spirochaeta* (*Borrelia*) *duttoni* [*cf. R.A.E.*, B **39** 98; **41** 97] by feeding on infected mice or by inoculation of the blood of mice into the haemocoele or rectum. The spirochaetes multiplied vigorously in the haemolymph after inoculation into the haemocoele, but did not always invade the haemocoele after rectal inoculation or ingestion. In some rectally inoculated lice, spirochaetes were found in the haemolymph after 24 hours, and their progressive accumulation on successive days was observed by amputating legs of the lice and examining the fluid exuded. There was no evidence of a granular phase in the developmental cycle [*cf.* **41** 95, etc.] irrespective of the method of infection adopted, and no spirochaetes were found in the organs or ova of the lice. Infection was not harmful to them, and one strain was maintained for eight months by louse to louse transfers, mainly by inoculation into the haemocoele in aseptically obtained haemolymph. When returned to mice after 21 passages through lice, it remained infective for the tick, *Ornithodoros moubata* (Murr.), and mice that had been infected 3–5 months previously with the original strain were immune to that from the lice.

Grandori (R.), Grandori (L.) & Facetti (D.). **Effetti tossici selettivi della carbacolina su alcune specie di insetti.** [Selective toxic Effects of Carbacholine on certain Species of Insects.]—*Boll. Zool. agr. Bachic.* **17** fasc. 2 pp. 123–128, 2 refs. Turin, 1951.

Carbacholine (aminoformyl-β-hydroxyethyltrimethylammonium chloride) is a white, crystalline, hygroscopic powder, soluble in water but not in ether or chloroform. It is stable in solution, melts at 202°C., and has a physiological action similar to that of acetylcholine. In the tests described, it was found to act as a selective insecticide after the manner of the urethane 19258 (5,5-dimethyldihydroresorcinol-dimethylcarbamate [Dimetan]) [*cf. R.A.E.*, A **40** 360]. It produced toxic symptoms on injection into adults of *Musca domestica* L. at a concentration of 0·01 per cent., caused 50 per cent. mortality at 0·046 per cent. (corresponding to 1·1 mmg. chemical per fly) and complete mortality in a short time at 0·1 per cent., and resulted in instant death at 0·25 per cent. When the flies were confined

on glass that had been sprayed with solutions of carbacholine, a deposit of 1·2 gm. per sq. metre gave 100 per cent. kill in two hours, or in four hours if the flies were removed to clean containers after the first hour. A deposit of 7·5 gm. gave 100 per cent. kill in two hours on the day of application and 32 days later, and one of 0·7 gm. gave 100 per cent. knockdown and kill in 7 and 24 hours on the day of application and 100 per cent. kill in 26 hours after 40 days. Flies of laboratory strains resistant to DDT and chlordane were as susceptible to carbacholine as normal flies. On the other hand, injection into adults of *Leptinotarsa* (*Doryphora*) *decemlineata* (Say) of solutions at rates of up to 1 mg. carbacholine per insect had no effect whatever, and adults of *Epicometis* (*Tropinota*) *hirta* (Poda) and *Calandra granaria* (L.) were also resistant to high doses.

Hornstein (I.) & Sullivan (W. N.). **The Role of Chlorinated Polyphenyls in improving Lindane Residues.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 937–940, 8 refs. Menasha, Wis., 1954.

It has been shown that the persistence and appearance of deposits of γ BHC as lindane can be improved by applying the lindane in a mixture of chlorinated terphenyls available commercially as Aroclor 5460 [*R.A.E.*, B **41** 143]. The vapour pressure of the lindane is lowered in the films [*cf.* **42** 74], but though the fumigating effect is materially reduced, it is not eliminated. Two weeks after the inside of a large glass vessel had been coated, 50 per cent. of caged adults of *Musca domestica* L. not in contact with the treated surface were killed after exposure for 10 minutes. When a low-pressure aerosol containing five parts each by weight of lindane and chlorinated terphenyls, 40 parts of methylene chloride and 50 parts of Freon-12 [dichlorodifluoromethane] was sprayed on the foliage of a willow tree, which was exposed to summer weather in Maryland, leaf samples contained 250 and 200 mmg. lindane per sq. inch after 30 and 60 days, respectively. There were no obvious ill effects on the leaves. Flies caged around a treated branch 70 days after treatment showed 90 per cent. mortality, and all those on untreated branches survived.

Trials of various methods of improving coatings on porous materials were made on unpainted plywood. Wetting the surface with water before applying the lindane and chlorinated terphenyls as a solution in a low-boiling oil solvent appeared promising, as the water prevents the solution from reaching, and consequently penetrating, the surface, and the solvent evaporates in a short time. Pressurised sprays containing low-boiling solvents gave good surface deposits. With a suitably adjusted concentration of a very volatile solvent (such as methylene chloride) in the pressurised-spray formulation, most of the solvent evaporated before the mixture of lindane and chlorinated terphenyl reached the surface. Also, a nearly saturated solution of the mixture in acetone and water can be prepared, and the surface wetted with water before treatment so that the acetone dissolves in the water and precipitates the mixture out of solution. The deposit is adherent though somewhat unsightly, and the method may be useful where appearance is not important. A stable homogenised suspension of a xylene solution of lindane and chlorinated terphenyls in water also gave promising results.

Gersdorff (W. A.) & Mitlin (N.). **The relative Toxicity to House Flies of the Methyl and Ethyl Analogs of Allethrin.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 945–948, 9 refs. Menasha, Wis., 1954.

The analogues of allethrin having methyl or ethyl instead of allyl in position 2 of the cyclopentenolone nucleus [*cf. R.A.E.*, B **41** 2] were tested

for toxicity to *Musca domestica* L. in comparison with allethrin and pyrethrins by the Campbell turntable method [**26** 246; *cf.* also **41** 135]. The methyl analogue was 0·12 as toxic as allethrin and 0·4 as toxic as pyrethrins. The ethyl analogue was 0·26 as toxic as allethrin and 0·94 as toxic as pyrethrins. Knockdown of flies was complete for the sprays containing the analogues at the concentrations used. From this study and a further consideration of previous work [**39** 136], it is concluded that an unsaturated side chain in position 2 of the cyclopentenolone nucleus of pyrethroids is not essential to relatively high toxicity and does not necessarily ensure it [*cf.* **39** 136], but that where comparison of corresponding esters is possible, dehydrogenation of an alkyl side chain is accompanied by an increase in toxicity of the ester.

Gahan (J. B.), Anders (R. S.), Highland (H.) & Wilson (H. G.). **Baits for the Control of resistant Flies.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 965–969. Menasha, Wis., 1954.

The following is based on the authors' summary. Laboratory and field tests were carried out in Florida to evaluate bait formulations as a means of controlling house-flies (*Musca domestica* L.) resistant to chlorinated-hydrocarbon insecticides. In laboratory tests, TEPP [tetraethyl pyrophosphate], sodium fluoroacetate, sodium arsenate and sodium arsenite proved to be the most effective of 15 water-soluble toxicants. Concentrations of TEPP above 0·5 per cent. were somewhat repellent, both in water and in a 5 per cent. water solution of malt. Some of the other materials showed repellency at a concentration of 5 per cent. in water alone but not when malt was added.

Baits in open metal pans were tested in three unscreened dairies. The baits contained 2 per cent. sodium arsenate, 50 per cent. blackstrap molasses or malt and 48 per cent. water, and were replaced weekly. A reduction in fly abundance ranging between 49 and 89 per cent. occurred during the first 24 hours, and the control gradually increased to 90 per cent. or above during the second and third week of the test. Two dairies were treated with water solutions containing 0·05 per cent. TEPP and 3 per cent. blackstrap molasses, and the same formulation with the addition of 0·3 per cent. lindane [γ BHC] was used in two others. As TEPP loses its toxicity rapidly in water, the solutions were applied to the floors with a garden sprinkling can in places where flies congregated. Applications were made daily for 15 days and five times weekly thereafter in one dairy and four or five times each week in the others, and 3 U.S. gals. solution were used for each treatment. A high degree of control (an average of 80 per cent. or over in most weeks) was obtained in all the dairies except one of those treated with the mixture of TEPP and lindane, where there was an unusually large breeding area near the building. The lindane did not materially increase the effectiveness of the bait in the other dairy in which it was used. The sodium-arsenate bait set out in pans seemed to have several advantages over TEPP applied with a sprinkling can. It gave better results with less labour and material, and is probably safer.

Perry (A. S.), Fay (R. W.) & Buckner (A. J.). **Dehydrochlorination as a Measure of DDT-resistance in House Flies.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 972–976, 3 figs., 11 refs. Menasha, Wis., 1954.

Various methods of application and criteria of effectiveness have been used in measuring resistance of house-flies [*Musca domestica* L.] to DDT

and other halogenated-hydrocarbon insecticides. Discrepancies in results from different studies can be attributed to variations in laboratory techniques and to the use of the dosage-mortality curve as the only criterion for measuring resistance. The amount of DDT absorbed is not always proportional to the amount applied, especially if a volatile solvent is used [*cf. R.A.E.*, B **41** 122], and the unabsorbed insecticide plays no significant part. A technique is proposed for measuring DDT-resistance, based on the amount of DDT absorbed and its rate of conversion to 2,2-bis(p-chlorophenyl)-1,1-dichloroethylene (DDE), in two hours at 25°C. [77°F.] and a relative humidity of 70 per cent. It involves colorimetric determinations of external and internal DDT and DDE [*cf.* **40** 56] two hours after application of a measured dosage of the insecticide (6·8 mmg. p,p′DDT in benzene) to the ventral thorax of individual female flies. In tests with flies of five strains ranging from susceptible to highly resistant, the results of which are given, the amounts of DDT absorbed were fairly uniform in nearly all strains after two hours, but greater differences appeared later. There was no correlation between absorption of DDT and resistance, but correlation between detoxification rates and survival was good. Degree of resistance can therefore be measured quantitatively as a function of the detoxification potential of a given strain. An index is proposed for adoption, the index figure corresponding to the percentage conversion of absorbed DDT to DDE, and classification of resistance as none, slight, moderate, medial, high or extreme is suggested, corresponding to indices of 0–10, 11–20, 21–35, 36–55, 56–75 and over 75. Measurement of resistance by mortality is based on a complete response or absence of response in each insect, and the results are satisfactory for practical control. The method proposed, in which resistance is measured by a graded response of each insect while it is still living, provides a more sensitive method of comparing the degree of resistance for basic studies.

Babers (F. H.) & Pratt jr. (J. J.). **Resistance of Insects to Insecticides: the Metabolism of injected DDT.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 977–982, 1 fig., 19 refs. Menasha, Wis., 1954.

The following is based on the authors' summary. The ability of a resistant strain of *Musca domestica* L. to metabolise DDT was compared with that of a susceptible strain following the topical application on individual flies or injection into them of measured dosages. Analyses of tissue extracts showed that, at low dosages of DDT, more 2,2-bis(p-chlorophenyl)-1,1-dichloroethylene (DDE) was recovered from resistant insects than from susceptible ones. However, the susceptible insects were able to metabolise DDT to DDE and an unknown metabolite. At high dosages of DDT, the ability of the resistant strain to metabolise DDT was blocked to a considerable degree. It is, therefore, concluded that the resistance of houseflies to insecticides is still an unexplained phenomenon.

Goodhue (L. D.) & Stansbury (R. E.). **Some new Fly Repellents from Laboratory Screening Tests.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 982–985, 2 refs. Menasha, Wis., 1954.

Since flies are becoming resistant to many formerly effective insecticides, the use of repellents against them is being considered, and over 500 chemicals were tested against house-flies [*Musca domestica* L.] for this purpose. Strips of black molasses on a piece of cardboard were dried and covered with strips of thin porous paper impregnated with the test chemical, and

the sandwich thus formed was offered to hungry flies with the cardboard curved in a holder so that the paper, through which the flies could feed, was held firmly against the molasses. If the chemical was not repellent, the molasses was soon consumed. The results obtained with the seven most effective chemicals are given. The most satisfactory were diethyl isocinchomeronate, di-n-propyl isocinchomeronate, tert.-dodecylmercaptopolyoxyethylene and a butadiene-furfural copolymer. The others had unpleasant properties making them unsuitable for practical use. Diethyl isocinchomeronate and di-n-propyl isocinchomeronate applied to the windows of a Peet-Grady chamber as a light spray in acetone solution (2 per cent.) repelled 90 per cent. of house-flies after four weeks, and tert.-dodecylmercaptopolyoxyethylene applied to screen doors by swabbing was repellent for at least two months.

The seven repellents most effective against house-flies were then tested against stable flies [*Stomoxys calcitrans* (L.)] on organdie bags drawn over the hand. The covered hand was exposed to several thousand hungry flies and the time to the first bite recorded. If no bites were received in five minutes, the bags were hung up and tested again next day. The best of the repellents, which included di-n-propyl isocinchomeronate and butadiene-furfural copolymer, prevented biting after three days but not after four. Diethyl isocinchomeronate showed considerable toxicity to rabbits when applied to the skin and di-n-propyl isocinchomeronate caused some irritation, but neither gave any evidence of toxicity when used on calves at practical dosages.

Goodhue (L. D.). **Some Observations on the Use of Isoparaffin Oils as Carriers for agricultural Chemicals.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 986–988, 2 refs. Menasha, Wis., 1954.

Most of this paper is concerned with the factors that make certain isoparaffins of value as carriers of insecticides or other chemicals applied to plants and is noticed elsewhere [*R.A.E.*, A **42** 288]. They are essentially complex mixtures of saturated branched-chain paraffin hydrocarbons, and the two fractions used in the study, Soltrol 140 and Soltrol 180, had boiling ranges of 361–400 and 402–481°F. The physical and chemical properties of both, and the solubilities of several insecticides and other chemicals in Soltrol 180 are given in tables. It was found that they spread much better on leaves, and are much less injurious to plants than ordinary hydrocarbon oils in the same boiling range, though some chemicals, including toxaphene but not aldrin, exhibited extreme phytotoxicity when applied in one of them (Soltrol 180).

It has been found by C. C. Crawford and L. L. Jaquier that pyrethrum, DDT, chlordane and a thiocyanate (Lethane 384) are more toxic to house-flies [*Musca domestica* L.] when applied in Soltrol than when applied in the best deodorised kerosene. The increase in toxicity, which is greatest with Soltrol 140 but also great with Soltrol 180, is attributed to synergism, but may be due to better spreading of the isoparaffins and more rapid absorption of the insecticides. In view of this and the fact that its toxicity to mammals appears to be low, Soltrol 180 would seem to show promise as a base oil for dairy sprays. In comparative tests in which the clipped trunks of rabbits were painted daily with the oils, kerosene and deodorised kerosene killed the animals after 4–7 paintings, whereas those treated with Soltrol 180 were not systematically affected after 21 paintings, though the skin became harder and more wrinkled than normal. One rabbit that was dipped in Soltrol 180 without clipping lived and gained weight, although the skin was hard and wrinkled for a time.

Gersdorff (W. A.) & Mitlin (N.). **Effect of molecular Configuration on relative Toxicity to House Flies as demonstrated with the four *trans* Isomers of Allethrin.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 999–1003, 5 refs. Menasha, Wis., 1954.

All the four possible *trans* stereoisomers of allethrin [*cf. R.A.E.*, B **40** 116] have recently been prepared, and this paper contains the results of tests by the turntable method [**26** 246] of their toxicities to house-flies [*Musca domestica* L.] in comparison with that of allethrin. They are referred to as the *l-d*, *d-l*, *l-l* and *d-d* esters, the first and second letters in each pair showing the optical activities of the allethrolone and acid components of the molecule, respectively. The *l-l*, *d-l*, *l-d* and *d-d* esters were found to be 0·022, 0·14, 0·58 and 3·4 times as toxic as allethrin. It thus appears that with the same acid component the change from the *l* to the *d* form of the allethrolone component is accompanied by a six-fold increase in toxicity, and with the same allethrolone component the change from the *l* to the *d* form of the acid component is accompanied by a 25-fold increase in toxicity. The change in each component simultaneously from the *l* to the *d* form is accompanied by the product of the separate effects. All the stereoisomers caused high knockdown of flies at the concentrations needed to cause high mortality. The order of decreasing effectiveness in both knockdown action and toxicity is *d-d*, *l-d*, *d-l* and *l-l*. The decrease is greater for knockdown, especially in the last two esters.

Keller (J. C.) & Chapman (H. C.). **Tests of selected Insecticides against resistant Salt-marsh Mosquito Larvae.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 1004–1006, 3 refs. Menasha, Wis., 1954.

Various chlorinated hydrocarbons and phosphorus compounds were tested in Florida in the laboratory and in the field against larvae of strains of *Aëdes taeniorhynchus* (Wied.) and *A. sollicitans* (Wlk.) resistant to DDT [*R.A.E.*, B **39** 58]. In laboratory tests, larvae highly resistant to DDT from an area that had been intensively treated with DDT from 1945 to 1949 and with BHC from 1950 to 1952 were less susceptible to all the insecticides tested against them than larvae from an occasionally treated area in the same county that were considered moderately resistant to DDT. These insecticides, grouped in descending order of toxicity were: EPN [ethyl p-nitrophenyl thionobenzenephosphonate]; heptachlor, dieldrin and aldrin; γ BHC as lindane and toxaphene; DDT and malathion; and tetrapropyl dithiopyrophosphate. Parathion, which was tested against the less resistant larvae only, would class with the three of the second group, which were highly toxic. In small-plot field tests, in which the compounds were applied in emulsions at 0·0025–0·1 lb. per acre in the intensively treated area against mixed populations of the two species, parathion, EPN, dieldrin and heptachlor gave 100, 99, 93 and 92 per cent. control of fourth-instar larvae at 0·01 lb. per acre, and all four gave 100 per cent. at 0·025 lb. Lindane and chlordane gave 100 per cent. control and malathion and DDT 98 and 90 per cent. control at 0·05 lb. per acre. TEPP [tetraethyl pyrophosphate] and tetrapropyl dithiopyrophosphate were relatively ineffective. In practical-scale tests in which insecticides were applied from aircraft at various concentrations in oil solution at a rate of 3 U.S. quarts per acre, lindane, heptachlor and dieldrin at 0·1 lb. per acre and chlordane at 0·4 lb. gave nearly complete control of mixed populations of larvae in the occasionally treated area, lindane at 0·05 lb. and toxaphene, chlordane and DDT at 0·2 lb. gave about 90 per cent. control, and aldrin and chlordane at 0·1 lb. gave only 69 and 29 per cent., respectively. DDT at 0·4 lb. per acre and

aldrin at 0·2 lb. were the only insecticides tested in the intensively treated area, where DDT gave 77 per cent. control of larvae of the two species and aldrin gave no control of *A. sollicitans*.

KELLEN (W. R.). **Laboratory Experiments on the Role of Insects in Sewage Oxidation Ponds.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 1041–1048, 6 figs., 5 refs. Menasha, Wis., 1954.

The use of oxidation ponds for secondary treatment of sewage has been rather widely adopted in California and is one of the most economical means of treating sewage where land is available and the climate is mild. Natural blooms of unicellular algae occur in the ponds and use the end products of bacterial oxidation of the sewage in the formation of cellular material, releasing oxygen in their photosynthetic processes. They are beneficial in supplying oxygen for aerobic oxidation of the sewage in daylight hours, but may compete with the bacteria for oxygen during the night and increase the biochemical oxygen demand of the ponds or the stream receiving the final effluent by becoming senescent and adding their cellular materials to the organic load. It thus appears that any agency operating towards the removal of algal cell material would be beneficial to the working of the ponds. Certain species of insects, especially Chironomids (Tendipedids) feed on algal material and remove it from the system when they pupate and emerge as adults. Controlled laboratory experiments with larvae of *Glyptotendipes barbipes* (Staeger) indicated that these larvae actively and significantly reduce the biochemical oxygen demand of the effluent materials. They remove algae whatever the detention period (the time the sewage is held in the ponds), but their action is most effective and the best stabilised effluents were obtained in the shortest time when the detention period is just long enough to allow bacterial oxidation of the organic material initially in the sewage, but not long enough to allow algal density to increase to a high level. A single series of tests with Hydrophilid beetles indicated that they do not very effectively remove algae from suspension.

FISK (F. W.) & ISERT (J. A.). **Comparative Toxicities of certain organic Insecticides to resistant and non-resistant Strains of the German Cockroach, *Blattella germanica* (L.).**—*J. econ. Ent.* **46** (1953) no. 6 pp. 1059–1062, 1 fig., 11 refs. Menasha, Wis., 1954.

A chlordane-resistant strain of *Blattella germanica* (L.) reared from resistant cockroaches found in Texas [*R.A.E.*, B **41** 179] and a DDT-resistant strain that had acquired its resistance in the laboratory [**41** 139] were compared with a normal strain to determine the degree of their resistance to DDT, chlordane, dieldrin, synergised allethrin and Diazinon (O,O-diethyl-O-[2-isopropyl-4-methyl-pyrimidyl(6)] thiophosphate). The test insecticides were dissolved at several concentrations in a mixture of refined kerosene and acetone (8:2), and droplets of the solutions were applied topically between the prothoracic coxae of anaesthetised female cockroaches at one mml. per insect. The mortality percentages obtained after 48 hours at 25°C. [77°F.] were used to compute log-probit dosage-mortality curves from which the median lethal doses were calculated. The degree of resistance in a resistant strain was calculated by dividing the median lethal dose for it by that for the normal strain. Both test strains showed some resistance to all the insecticides used. The degrees of resistance to DDT, chlordane, dieldrin, Diazinon and allethrin were 1·9, 1·8, 1·2, 2·4 and 1·7 in the DDT-resistant strain, and 1·4, 108·6, 68·0, 1·2

and 1·3 in the chlordane-resistant strain. The low degree of resistance of the DDT-resistant strain to DDT is attributed to the fact that nine generations had been completed without exposure to DDT since Grayson established its resistance as 14·3 times that of a control strain [**39** 167]. However, the chlordane-resistant strain had also passed through about nine generations without exposure to insecticides. It is suggested that it may have been more homozygous for resistance than the DDT-resistant strain [*cf.* **42** 55].

Goodwin (W. J.), Moore III (S.) & Schwardt (H. H.). **Horse Fly and Horn Fly Repellent Tests on Cattle in New York.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 1088–1089, 2 refs. Menasha, Wis., 1954.

Experiments with repellents against *Tabanus* spp. and *Siphona irritans* (L.) in New York [*R.A.E.*, B **40** 95], were continued in 1952, when four were compared in emulsion sprays. The cattle were sprayed after the morning milking at about 1 U.S. quart per animal and observations of populations were made on the afternoon of treatment and on the third, fifth and seventh days thereafter. Pyrenone (1 per cent. pyrethrins and 10 per cent. piperonyl butoxide), which was used in three tests at a dilution of 1:10, showed consistent high repellency to *Tabanus* and almost complete repellency to *Siphona* for five or seven days, according to weather. Butoxypolypropylene glycol [*cf.* **38** 86] used at 1:9 was less effective against *Tabanus* but nearly as good against *Siphona*, and the two other preparations gave inconsistent or inferior results.

Piquett (P. G.) & Fales (J. H.). **Life History of** *Blaberus giganteus* **(L.).**—*J. econ. Ent.* **46** (1953) no. 6 pp. 1089–1090, 1 fig., 5 refs. Menasha, Wis., 1954.

A strain of *Blaberus giganteus* (L.), which occurs in Central and South America, was maintained in a laboratory in Maryland at 85°F. and 60 per cent. relative humidity for three years. This cockroach is ovoviviparous. In 13 reared individuals of both sexes on which observations were made, the nymphal stage lasted 139–201 days with an average of 172 days; and four individuals that were carefully watched moulted seven or eight times. One individual lived 532 days as an adult and another was still living after 612 days, and one birth-to-birth cycle of 330 days was noted.

Clark (E. W.). **An acaricidal Formulation for Canine Demodecosis.**—*J. econ. Ent.* **46** (1953) no. 6 p. 1093, 4 refs. Menasha, Wis., 1954.

As benzyl benzoate and various chlorinated insecticides used separately have recently been found effective for treatment of dogs infected by *Demodex canis* Leydig [*cf. R.A.E.*, B **38** 78], tests were made of the effectiveness of mixtures containing DDT, benzyl benzoate and chemicals that might increase penetration and adherence. The best formula of those tried was 20 ml. benzyl benzoate, 1 gm. DDT, 2 gm. stearic acid, 12 ml. Tween 80 and 66 ml. water, to which benzyl alcohol or benzocaine may be added to ease pruritus. The emulsion was massaged into the skin of the dog three times at intervals of three days, and the area treated extended well beyond that showing symptoms. Mortality of mites 3–5 days after the first application was high. If no living mites or fresh symptoms were seen within 30 days of the last treatment, no further application was needed.

The treatment promoted healing. As the mites attack only dogs in poor physical condition [*cf.* **37** 91], control should be supplemented with improved diet and general care.

Shaw (F. R.) & Clark (G.). **Notes on certain Ectoparasites in Massachusetts.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 1093–1094, 2 refs. Menasha, Wis., 1954.

Fleas reported to be occurring in the nest boxes of a hen house in Massachusetts and biting man were found to be *Orchopeas wickhami* (Baker) (*howardii* (Baker)), a species that is normally an ectoparasite of grey squirrels limited in its distribution by the presence of its host. In 1953, an engorged female of *Dermacentor variabilis* (Say) was removed at Amherst, in central Massachusetts, from a dog that was not known to have been to infested parts of the State. This record appears to support the theory that *D. variabilis* is increasing its range [*R.A.E.*, B **40** 61].

Babers (F. H.) & Roan (C. C.). **The Dehydrochlorination of DDT by resistant Cockroaches.**—*J. econ. Ent.* **46** (1953) no. 6 p. 1105, 5 refs. Menasha, Wis., 1954.

Experiments were carried out to determine whether cockroaches (*Blattella germanica* (L.)) of a Texas strain highly resistant to chlordane and somewhat so to certain other insecticides [*R.A.E.*, B **41** 179; **42** 136] could dehydrochlorinate DDT faster than a susceptible strain. The stock of the resistant strain had been reared for five generations without exposure to insecticide. Males were treated topically with 5 mmg. p,p′DDT in acetone and examined after 48 hours. The amounts of DDT found externally on living susceptible and resistant cockroaches and dead susceptible and resistant cockroaches were 2·360, 1·802, 2·486 and 1·896 mmg., respectively, and the amounts of DDT and (in brackets) of DDE [2,2-bis(p-chlorophenyl)-1,1-dichloroethylene] in them were 0·540 (0·113), 0·411 (0·133), 0·870 (0·085) and 1·050 (0·199) mmg.

It appeared from the amount of DDT unaccounted for that both strains metabolise considerable amounts of absorbed DDT to an unknown metabolite.

Jones (C. M.). **Biology of Tabanidae in Florida.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 1108–1109, 6 refs. Menasha, Wis., 1954.

Tabanids are very abundant in Florida because of the mild climate and the numerous lakes, streams and vast swampy areas that provide breeding grounds for them. Adults are active throughout the year in the south of the State and from March to October in the centre and north. A study of the bionomics and distribution of the more abundant species was undertaken in 1950, and a summary of the results is given. Of the 108 species and subspecies of 16 genera that have been recorded from Florida, 66 were collected during the investigations. Of these, 44 were seen to attack domestic animals and about 25 were plentiful enough to be important pests.

Four species of parasites were observed. *Telenomus tabanivorus* (Ashm.) was reared from several egg masses of *Tabanus atratus* F. and had usually parasitised more than half the eggs in them, and another species of *Telenomus*, apparently undescribed, emerged from an unidentified egg mass. A single adult of the Tachinid, *Phasiops flava* Coq. was reared from a *Tabanus* larva, and about 100 of *Trichopria tabanivora* Fouts from each of two pupae of *Tabanus lineola* F. The adult Tabanids were destroyed in

considerable numbers by predators, which included dragonflies, the Sphegid, *Bembix* (*Stictia*) *carolina* (F.), and lizards, and many were seen in spiders' webs.

LeRoux (E. J.) & Morrison (F. O.). **Dosage of DDT needed to kill a House Fly.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 1109–1110, 2 refs. Menasha, Wis., 1954.

DDT was applied to the tibio-femoral joint of one metathoracic leg or to the labella of males of the house-fly [*Musca domestica* L.] by Fisher's method [*R.A.E.*, B **41** 208] at 2 mmg. per fly. Amputation of the treated leg after 30 minutes considerably reduced mortality, but amputation of the leg after 4 hours or of labella after 30 minutes had no effect. When flies were similarly treated with radioactive DDT and later sectioned, the percentages of the total radioactivity that were in severed treated appendages were 91 in legs and 90 or 93 in labella after 30 minutes and 80 in legs after four hours. Thus, absorption and distribution of 10–20 per cent. of the applied dose produced the full lethal effect, and the site of application did not influence the rate of absorption but did influence effectiveness.

Mitchener (A. V.). **Control of Mosquito Larvae and Pupae with some chlorinated Hydrocarbons.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 1118–1119, 3 refs. Menasha, Wis., 1954.

Experiments on the effectiveness against mosquito larvae and pupae of aldrin, dieldrin, isodrin and endrin [*cf. R.A.E.*, B **41** 143–144] in comparison with DDT were continued in Manitoba in 1953, when toxaphene was also tested. The mosquitos were *Aëdes dorsalis* (Mg.) and *A. vexans* (Mg.). The chemicals were tested by adding emulsion concentrates to distilled water to give concentrations of 1, 0·5, 0·2 or 0·1 part toxicant per million and exposing the larvae or pupae for 24 hours. All gave 100 per cent. kill of larvae at 1 p.p.m. and over 96 per cent. at 0·5 and 0·2 p.p.m., except toxaphene, which gave about 96, 93 and 91 per cent. kill at these three concentrations. At 0·1 p.p.m., DDT and endrin gave 98 per cent. kill, aldrin and dieldrin 95 per cent., toxaphene 84 per cent. and isodrin 81 per cent.

Against pupae, endrin gave 98·9 per cent. kill and dieldrin and isodrin both over 70 per cent. at 0·5 p.p.m., and all three gave about 60 per cent. at 0·2 p.p.m. The other chemicals were relatively ineffective.

Hess (A. D.). **Current Status of Insecticide Resistance in Insects of Public Health Importance.**—*Amer. J. trop. Med. Hyg.* **2** no. 2 pp. 311–317, 16 refs. Baltimore, Md., 1953.

To supplement a previous paper [*R.A.E.*, B **42** 53], recent developments in resistance to DDT and other chlorinated hydrocarbons in insects of importance to public health in various parts of the world are reviewed from the literature and from personal communications made to the author, and are summarised in a table. Where resistance has been confirmed experimentally, this is indicated. Records based on general field observations are becoming increasingly common. While *Musca domestica* L. shows high levels of resistance in most parts of the world, *M. d. vicina* Macq. and *M. d. nebulo* F. still show no significant resistance in India and Ceylon, even where DDT deposits have been extensively used for several years, although the former has developed resistance in Israel and elsewhere and the latter

to some extent in the laboratory [*cf.* **42** 124]. Additional evidence of resistance in Anophelines reported personally during the year included resistance to DDT and BHC (gammexane) in *Anopheles maculipennis sacharovi* Favr in Greece and to DDT in *A. superpictus* Grassi in Turkey, and slight resistance to DDT in *A. quadrimaculatus* Say in the United States. Resistance to DDT is also reported in larvae of *Culex tarsalis* Coq. and *Aëdes nigromaculis* (Ludl.) in parts of California [*cf.* **41** 48], where ethyl p-nitrophenyl thionobenzenephosphonate (EPN) has since shown promise against them, in larvae of *Culex pipiens pipiens* L. from heavily treated areas in Ohio, and in body lice [*Pediculus humanus humanus* L.] in parts of Egypt in which dusting has been carried out every 3–5 months since 1948 and on Palestine refugees.

Mathis (W.) & Quarterman (K. D.). **Field Investigations on the Use of heavy Dosages of several chlorinated Hydrocarbons as Mosquito Larvicides.**—*Amer. J. trop. Med. Hyg.* **2** no. 2 pp. 318–324, 3 refs. Baltimore, Md., 1953.

The results are given of continued tests in Georgia of the duration of effectiveness of chlorinated-hydrocarbon insecticides against mosquito larvae in small land-locked ponds [*cf. R.A.E.*, B **41** 54]. All the larvicides tested were applied as emulsified solutions at heavy dosages. Dieldrin was much the most effective and prevented breeding for 62–78 weeks when applied at 1 lb. per acre to ponds containing water and larvae. DDT at 3 lb. per acre was effective for only 13–23 weeks, and the addition of resin to the concentrate did not significantly improve its action. BHC (12 per cent. γ isomer) and toxaphene, both at 1 lb. per acre, gave effective control for only 3–8 and 4–6 weeks. Pre-flood applications at 3 lb. per acre to dry ponds subsequently filled by rain also showed the superiority of dieldrin, which prevented breeding for more than 18 weeks under these conditions. DDT and DDD were nearly as good and sometimes remained effective for more than 17 weeks.

Treatment of ponds five times each summer for three consecutive years with BHC at 1 lb. per acre caused no injury to fish. All the other materials were very harmful to fish and other aquatic fauna and should not be applied at the concentrations mentioned where these are of importance.

Reeves (W. C.). **Quantitative Field Studies on a Carbon Dioxide Chemotropism of Mosquitoes.**—*Amer. J. trop. Med. Hyg.* **2** no. 2 pp. 325–331, 1 graph, 3 refs. Baltimore, Md., 1953.

The following is based on the author's summary of field experiments in California. Carbon dioxide, released at about 25, 250 and 2,500 ml. per minute, approximately the rates at which it is given off by a fowl, a man, and a horse or cow, respectively, was successfully used as a host-simulating bait for mosquitos. Large numbers of female mosquitos of various species were attracted into the carbon-dioxide baited traps. *Aëdes nigromaculis* (Ludl.) was attracted in the greatest numbers by the highest rate of release of carbon dioxide and *Culex pipiens fatigans* Wied. (*C. quinquefasciatus* auct.) by the lower ones. *C. tarsalis* Coq. was greatly attracted by all three rates, but the highest rate was the most attractive and the smallest the least. These observations are correlated with available knowledge on the host preferences of the three species and suggest a direct relationship between host-seeking and carbon-dioxide chemotropism. They suggest a new procedure for use in epidemiological studies of mosquito-borne diseases.

Fox (I.). **Notes on the Cat Flea in Puerto Rico.**—*Amer. J. trop. Med. Hyg.* **2** no. 2 pp. 337–342, 4 figs., 15 refs. Baltimore, Md., 1953.

It is believed that many records of *Ctenocephalides canis* (Curt.) in the literature are the result of misidentification of *C. felis* (Bch.), a species that is of importance as a potential vector of murine typhus [*cf. R.A.E.*, B **34** 2]. In the course of recent ectoparasite surveys in the residential section of San Juan, Porto Rico, 938 rats (*Rattus norvegicus* and *R. rattus*) were examined during 1946–49 [**40** 189] and 15 stray dogs in July and August 1950. *C. canis* was not found, whereas 17 examples of *C. felis* were taken on 16 rats (all *R. norvegicus*) and it was abundant on all the dogs. An examination of published records of the occurrence of *C. canis* in Porto Rico failed to produce acceptable evidence that the species was present there. The specimen figured as *C. canis* by Maldonado Capriles [**37** 17] was an exotic one, as none could be collected locally, and the only specimen from Porto Rico labelled as *C. canis* in the United States National Museum was found by Muesebeck to be *C. felis*. It is concluded that *C. canis* is absent from Porto Rico, the flea recorded from there by that name being *C. felis*. The same probably applies in some of the other countries from which *C. canis* has been recorded.

The five important characters that separate the two species were studied in 50 females and 40 males of *C. felis*, and the least variable was found to be the shape of the head. This by itself allows of identification. The relative lengths of the first and second genal spines, the distal expansion of the manubrium, the size of the abdominal spiracles and the hind tibial chaetotaxy are highly variable, although within defined limits. Until a similar study of the intraspecific variations of *C. canis* is made, it is impossible to tell whether forms intermediate between the two species occur.

Domestic Rats, Rat Ectoparasites and Typhus Control.—*Publ. Hlth Monogr.* no. 5, iii + 37 pp., 4 figs., 33 refs. Washington, D.C., 1952.

This publication comprises three papers: **Domestic Rats in Relation to Murine Typhus Control,** by H. B. Morlan, B. C. Utterback & J. E. Dent (pp. 1–20, 3 figs., 19 refs.); **Ectoparasites of Domestic Rats in Relation to Murine Typhus,** by Morlan & Utterback (pp. 21–30, 1 fig., 8 refs.), and **Commensal Rat Ectoparasite Collections in Oklahoma,** by M. J. Wilcomb jr., M. E. Griffith & L. L. Ellis (pp. 31–37, 6 refs.). The first two are reports on a study of the data on the rats and on their ectoparasites obtained during an evaluation made in south-western Georgia of county-wide dusting with DDT for the control of murine typhus, the general results of which have already been noticed [*R.A.E.*, B **39** 108, 145; **40** 166]. The following are abstracts of the second and third papers, based mainly on the authors' summaries.

Over 20,000 domestic rats (*Rattus* spp.) were trapped in south-western Georgia from May 1946 to April 1949. *Xenopsylla cheopis* (Roths.), *Leptopsylla segnis* (Schön.), *Bdellonyssus* (*Liponyssus*) *bacoti* (Hirst) and *Polyplax spinulosa* (Burm.) accounted for nearly 95 per cent. of the ectoparasites recovered from them. Percentages of rats infested with *B. bacoti* were consistently higher for *R. rattus* than for *R. norvegicus*, but the data suggested a normal tendency for *X. cheopis*, *L. segnis* and *P. spinulosa* to infest slightly higher proportions of *R. norvegicus* than *R. rattus*. *P. spinulosa* consistently infested a higher percentage of both species of rats than did any other ectoparasite. Rats that gave positive results in the complement-fixation test for murine typhus were more often infested with *X. cheopis* and *L. segnis* than were negative rats. Percentages of positive

and negative rats infested with *B. bacoti* and *P. spinulosa* were variable and inconclusive. Data indicate that *X. cheopis* and *B. bacoti* normally infest young rats more often than adult rats, but there was no apparent pattern to differences in infestation of adult and of young rats with *L. segnis* and *P. spinulosa*. Conclusive differences were not apparent in percentages of male and female rats infested with *X. cheopis*, *L. segnis* and *B. bacoti*, but higher percentages of males than of females were infested with *P. spinulosa*. Multiple catches (2–13 rats, without regard to species, sex or age) from the same building and on the same day were tabulated for the untreated control county. In the 705 multiple catches, all rats were infested with *X. cheopis* in 205 instances and part of the catch in 289 instances. Of the premises on which infested rats were trapped during and after the dusting, the percentages with one or more rats infested with *X. cheopis* were 81–90 in the untreated county and 11–76 in the treated counties. Females predominated in samples of *X. cheopis* and *L. segnis* taken from rats, the proportion of females being higher for *L. segnis* than for *X. cheopis*. There was some evidence that the DDT dusting was less effective against females than against males. The proportions of females in both *X. cheopis* and *L. segnis* were higher on *R. rattus* than on *R. norvegicus*. In the untreated county, there was a regular tendency for the proportion of females to males of *X. cheopis* to increase in months with a lower mean temperature and to decrease in months with a higher mean temperature.

The survey of commensal rat ectoparasites in Oklahoma comprises data from 1,051 rats collected from November 1949 to the end of June 1951 in 33 counties. Of the rats, 50 were *R. rattus* and were without ectoparasites; the remainder were *R. norvegicus*. Most of the ectoparasites were obtained from 758 of the latter collected alive. Mites, fleas and *Polyplax spinulosa* represented 66·6, 21·4 and 12 per cent. of these ectoparasites, and 1,299 examples of *Echinolaelaps (Laelaps) echidninus* (Berl.) and 709 of *X. cheopis* represented 52·3 and 89 per cent. of the mites and fleas, respectively. *X. cheopis* infested 11 per cent. of the live rats and was also found on dead ones of the same species. It was taken from 36 of the 221 establishments from which rats were obtained and occurred mainly in those handling food, animal feed, seed or grain in industrial districts. Blood specimens from 675 rats showed 20 positive for murine typhus. There were four individuals of *X. cheopis* on the one infected rat taken in one county and an average of 6·1 on the 19 collected in another.

Edgar (S. A.), Little (C. D.) & Herndon (J. F.). **Control of the Fowl Tick, *Argas persicus* (Oken), on an Alabama Poultry Farm.**—*J. Amer. vet. med. Ass.* **123** no. 920 pp. 446–447, 3 refs. Chicago, Ill., 1953.

Sulphur dust, aldrin, γ BHC as lindane and heptachlor were compared for the control of *Argas persicus* (Oken) in four small henhouses on a farm in Alabama in 1951–52. The ticks were fairly plentiful in cracks and other hiding places in the houses, but none was found in the yards or an unused brooder house. In October 1951, sulphur was sprinkled on the litter, roost poles and nests of one house at 2 lb. per 100 sq. ft. floor space, and the other houses were treated with sprays containing 0·6 per cent. aldrin in emulsified solution and 0·114 per cent. lindane and 1 per cent. heptachlor in suspensions, applied to the walls, roost, nests and floor at 500, 1,100 and 800 cc. spray per 100 sq. ft. surface, respectively. All applications were made in the morning. Fowls were allowed to remain in the house treated with sulphur, but were kept out of the others until evening. There

was no treatment of yards and no clearing of litter in yards or houses. In January 1952, many living ticks of all stages were found in the houses treated with sulphur and lindane, a few in the one treated with heptachlor and two in the one treated with aldrin. The sulphur-treated house was re-treated with a 0·67 per cent. suspension of aldrin at 800 cc. per 100 sq. ft. surface. A few living ticks were found in it three months later, when living ticks of all stages were seen in the houses treated with lindane and heptachlor, but none in the house originally treated with aldrin. A 2 per cent. spray of aldrin in emulsified solution was then applied at 1,200 cc. per 100 sq. ft. to the houses originally treated with sulphur and lindane and at 800 cc. to the one originally treated with heptachlor. All houses were carefully re-examined seven weeks and 6½ and 11 months later, and no living ticks were seen. There was no indication that the fowls were harmed by any of the treatments.

Weyer (F.). **Beobachtungen an einem Stamm von südafrikanischem Zeckenbissfieber (South African Tick-bite Fever).** [Observations on a Strain of South African Tick-bite Fever.]—*Z. Tropenmed. u. Parasit.* **5** pt. 2 pp. 205–218, 5 figs., 15 refs. Stuttgart, 1954. (With a Summary in English.)

The following is taken from the author's summary. Rickettsiae of South African tick-bite fever were maintained through several passages in mice by intranasal or intraperitoneal inoculation; they developed in the lung tissues in the first case and in the peritoneal cavity in the second. They multiplied rapidly in *Pediculus humanus humanus* L. (*P. h. corporis* Deg.), when the lice were fed on infected mice or inoculated with macerations of diseased organs, and they were transferred from louse to louse by inoculation, without losing their virulence for mice or guineapigs. After rectal inoculation, the rickettsiae multiplied in the cells of the stomach wall and occasionally passed to the haemolymph, where they reproduced extracellularly. After inoculation into the haemocoele, their development began in the haemolymph and secondary invasion of the stomach cells sometimes took place. In general, the stomach cells were not enlarged or otherwise impaired and infection did not necessarily shorten the life of the lice. The rickettsiae thus differed from those of Marseilles fever (*Rickettsia conori*), which were fatal to lice in a few days [*R.A.E.*, B **41** 101], and further investigations are desirable to determine whether this difference is constant, in view of divergent opinions on their status. The agent of South African tick-bite fever was formerly considered a distinct entity (*R. rickettsi* var. *pijperi*), but recent workers have concluded, on the basis of immunological and serological tests, that the agents of this and the other African tick-borne spotted fevers, including Kenya typhus and Nigerian typhus as well as Marseilles fever, are *R. conori*.

Roy (D. N.) & Brown (A. W. A.). **Entomology (medical & veterinary) including Insecticides & Insect & Rat Control.**—2nd edn., 10 × 7½ ins., ix + 413 pp., 14 pls., 194 figs., refs. Calcutta, Excelsior Press, 1954. Price *Rs.* 30 or £2 5*s*.

The first part of this text-book (pp. 1–290) is by Roy and is essentially similar to the first edition [*R.A.E.*, B **34** 188], though it has largely been re-written and brought up to date. The survey of the species of *Anopheles* that were believed to be the principal malaria vectors in the different parts

of the world and the various provinces of India has been omitted and replaced by a list of the species of importance in various parts of Asia, the Pacific islands and Australia. A second part (pp. 291–406), dealing with insecticides and pest control, has been added by Brown. It comprises three chapters on insecticides, including surveys of their chemistry (with notes on other ingredients of insecticide formulations), their modes of action, methods of testing them, the risks to man involved in their use, and apparatus and methods for applying them; and two chapters on the control of pests. The first of these contains a brief history of recent attempts to obtain local eradication of malaria by campaigns against Anophelines and notes on mosquito repellents, as well as sections on the control of mosquitos, *Phlebotomus*, *Simulium*, *Culicoides*, *Musca domestica* L., biting flies on livestock and flies parasitic on cattle, horses and sheep. The pests dealt with in the second are fleas, lice, bugs, cockroaches, Trombiculids, *Sarcoptes scabiei* (Deg.), mange mites of animals, ticks, other poisonous arthropods and rodents.

Parrot (L.) & Donatien (A.). **Autres observations sur l'infection naturelle des phlébotomes par la leishmaniose générale de l'homme et du chien en Algérie.**—*Arch. Inst. Pasteur Algér.* **30** no. 2 pp. 146–152, 12 refs. Algiers, 1952.

During 1943–50, the authors continued their studies on natural infection of *Phlebotomus* with visceral (general) leishmaniasis [*cf. R.A.E.*, B **31** 241] by examining more sandflies caught in kennels near Algiers housing dogs suffering from the disease in a more or less advanced stage. The females taken and dissected comprised 242 of *P. perniciosus* Newst., 333 of *P. longicuspis* Nitzu., 16 of *P. sergenti* Parr. and 7 of *P. minutus* var. *parroti* Adl. & Thdr., and of these 25, 51, 2 and 0 were infected with the flagellate forms of *Leishmania*. Most of the females except those of *P. m. parroti*, contained blood. The percentages infected in different months from April to October are shown. There were peaks in May and August. In 59 of the 78 infected females, including the two of *P. sergenti*, the flagellates had moved forward away from the stomach proper to the cardia. Intensity of infection varied considerably. In five females of *P. perniciosus* and 12 of *P. longicuspis*, flagellates were so abundant in the cardia immediately behind the oesophageal valve and once in the oesophagus itself that this part of the digestive tract appeared blocked.

Papers noticed by Title only.

Oldroyd (H.). **The Horse-flies (Diptera: Tabanidae) of the Ethiopian Region. Volume II. *Tabanus* and related Genera.**—10 × 7½ ins., x + 341 pp., 5 pls., 238 figs., 31 maps, 2½ pp. refs. London, Brit. Mus. (Nat. Hist.), 1954. Price £2 5*s*. [*Cf. R.A.E.*, B **40** 136.]

Sun (Jung-yi Tung) & Sun (Yun-pei). **Microbioassay of Insecticides in Milk by a Feeding Method** [using *Musca domestica* L.].—*J. econ. Ent.* **46** (1953) no. 6 pp. 927–930, 4 refs. Menasha, Wis., 1954. [See *R.A.E.*, A **42** 283.]

Sherman (M.) & Rosenberg (M. M.). **Acute Toxicity of four Chlorinated Dimethanonaphthalene Insecticides** [aldrin, dieldrin, isodrin and endrin] **to Chicks.**—*J. econ. Ent.* **46** (1953) no. 6 pp. 1067–1070, 7 refs. Menasha, Wis., 1954. [See *R.A.E.*, A **42** 296.]

JORDAN (P.). **Filariasis in the Southern Highlands Province of Tanganyika.** —*E. Afr. med. J.* **30** no. 9 pp. 361–367, 9 refs. Nairobi, 1953.

The results are given of a filariasis survey, carried out in all districts of the Southern Highlands Province of Tanganyika, from which it is concluded that bancroftial filariasis (*Wuchereria bancrofti*) is endemic in only two areas. One, at the northern end of Lake Nyasa [*R.A.E.*, B **29** 21], was found to be smaller than had been believed. The extent of the other was uncertain. The very low incidence of onchocercosis at Njombe, where *Simulium damnosum* Theo. and *S. neavei* Roub. have been found in large numbers [**29** 73], is tentatively attributed to the unsuitability of the climate for the development of *Onchocerca volvulus* in the Simuliids on account of the altitude (5,600 ft.).

HUGHES (M. H.). **Some Observations on the Bionomics of *Simulium damnosum* Theo. in the southern Gold Coast.**—*W. Afr. med. J.* (N.S.) **1** no. 1 pp. 16–20, 1 graph, 8 refs. Ibadan, 1952.

When the hydroelectric scheme on the lower Volta [*R.A.E.*, B **41** 147] is completed, rapids forming the breeding places of Simuliids for over 100 miles above the site will be submerged and only 15 miles of the river below the dam will remain available for breeding, not all of it suitable for *Simulium damnosum* Theo. As a campaign to eradicate this species will probably be undertaken there, its abundance was surveyed week by week from October 1950 to July 1951 to provide basic data. Fly-boys were instructed to catch every fly that attempted to bite them. *S. damnosum* was the species most often taken, followed by *Glossina palpalis* (R.-D.) and *G. fusca* (Wlk.). No other species of *Simulium* was caught. As the seasonal curve obtained for *G. palpalis* roughly resembled that obtained by Pomeroy & Morris [**21** 55], it was concluded that the boys worked consistently throughout the season and reliance could be placed on the curve for *S. damnosum*. The catches bore some relationship to the level of the river. This is only roughly equivalent to the product of the speed of the current and the area of breeding ground covered with water, which are more likely to be the significant factors. In the dry season, the breeding areas are very restricted. The weekly catches of *S. damnosum* ranged from about one to 180 per 100 boy-hours and often varied considerably in different weeks of a given month. They were highest in early October, April, May and June and very low from December to March. Only one out of 20 adults dissected in March was infected with *O[nchocerca] volvulus*, and it is likely that few survive to take their second blood-meal in the dry season. The way in which *S. damnosum* overcomes the dry season in the parts of the savannah belt in which the rivers are dry for several months is discussed. There is no evidence that the adults survive there, and it is believed that either they must enter from more favourable areas or an immature stage survives. Survival of the eggs is considered the most likely possibility. The need for full investigation to determine whether this occurs is stressed.

COLLESS (D. H.). **Observations on the Periodicity of natural Infections in the Anopheline Mosquitoes of Borneo.**—*Med. J. Malaya* **6** no. 4 pp. 234–240, 2 figs., 9 refs. Singapore, 1952.

The Anopheline that is probably the most important vector of malaria in Borneo is the one that was previously recorded by the author as *Anopheles leucosphyrus balabacensis* Baisas [*R.A.E.*, B **37** 145]. He here accords it

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specific status, though it is so closely allied to *A. leucosphyrus leucosphyrus* Dön. that Reid tentatively considered it identical with the latter [**40** 142]. Another species, which is thought to be of some importance, is *A. sundaicus* (Rdnw.) [*cf.* **37** 146]. Observations on natural infections in the vector species, made in the British Colonies of Borneo over a number of years, have, however, appeared to be conflicting and even led to doubt as to whether *A. sundaicus* is in fact a vector, and it is the object of this paper to suggest a reason why the mosquitos show infection at one time but not at another.

Some 1,840 females of *A. l. balabacensis* dissected in Labuan from July 1948 to May 1949 showed an overall sporozoite rate of 1·6 per cent. The numbers of females caught per man per night and (in brackets) the percentages showing sporozoites in the successive months were 5·6 (5·4), 2·3 (2·9), 3·4 (3·3), 1·9 (1·2), 1·6 (3·6), 1·8 (1·5), 0·2 (0), 0 (0), 1·1 (0), 3·3 (2) and 3·1 (1·6). This correspondence between numbers and sporozoite rates throughout most of the year led to the hypothesis that high populations are associated with lengthened adult life, which allows more females to live long enough for sporozoites to develop. It is known that *A. l. balabacensis* normally rests out of doors in moist shady places and is extremely susceptible to dessication. The high sporozoite rates were found to be associated with high rainfall and low wind strength, conditions that would favour survival by maintaining high atmospheric humidity. Temperature was not considered, as it fluctuates very little. However, rainfall also affects adult density directly by augmenting breeding places.

A. sundaicus has been found naturally infected with malaria parasites at least ten times in four places, and there are three records of sporozoites in it, each in a different area, but all three in June–July 1949. Long series of dissections are, however, often negative at times when the mosquito is plentiful. It appears to maintain low endemicity with occasional epidemics in certain coastal areas, but also occurs in areas that are relatively free from malaria and never suffer epidemics despite sudden rises in its numbers. These facts can all be explained as the effects of length of life on transmission, if it is assumed that the average life-span of females of *A. sundaicus* is rather delicately balanced around the critical period for maturing acquired infections. This assumption is supported by the preponderance of natural infections of the gut only. The effect of rainfall on abundance of *A. sundaicus* is complicated by the fact that it uses two kinds of breeding places, saline pools at the mouths of small coastal streams blocked by sand-bars, which are emptied when heavy rain washes away the bars, and small pools of fresh or slightly saline water around or above the tidal limits, which need rainfall to keep them filled. It would seem that mosquito abundance should be accompanied by shorter life if it results from breeding in the former and longer life if it results from breeding in the latter. In Labuan, gland infections have been found in *A. sundaicus* in a swampy area where it breeds in the pools, but not in areas where it breeds in the mouths of coastal streams. This further supports the hypothesis of a connection between transmission and long life. On the other hand, in the coastal areas of Brunei and Sarawak, which have experienced epidemics, almost certainly caused by *A. sundaicus*, adult density rather than length of life seems to be the chief limiting factor in transmission, as the epidemics have been associated with low rainfall and high tides.

It is suggested that if length of life is critical, transmission might be reduced by destroying potential resting sites near dwellings, thus forcing the females to travel greater distances in search of a blood-meal and so lessening their chance of survival. In Borneo, malaria is noticeably absent from cleared urban areas, and this may be partly due to lack of resting places as well as lack of breeding places. In many coastal areas, moreover,

there were epidemics in 1946, when formerly cleared areas had become badly overgrown, but there have been none since re-clearing.

Mallis (A.). **Handbook of Pest Control. The Behavior, Life History, and Control of Household Pests.**—2nd edn., $9\frac{1}{4}$ × 6 ins., 1068 pp., 231 figs., many refs. New York, N.Y., MacNair-Dorland Co., 1954. Price, post paid, U.S.A., $9.25; elsewhere, $9.75.

This second edition of a book on the life-history and control of household pests in the United States resembles the first one [*R.A.E.*, B **33** 150], but parts of it, especially those on the control of house-flies [*Musca domestica* L.] and mosquitos and on the insecticides used against these and other pests, have been greatly extended to bring it up to date.

Price (D. A.) & Hardy (W. T.). **Isolation of the Bluetongue Virus from Texas Sheep—*Culicoides* shown to be a Vector.**—*J. Amer. vet. med. Ass.* **124** no. 925 pp. 255–258, 2 figs., 7 refs. Chicago, Ill., 1954.

Epizootics of blue-tongue are reported to have occurred in sheep in western Texas in 1948, 1951 and 1953. They all began in May or June and ended during the autumn, and all originated along the Rio Grande River and spread northwards. The virus was isolated from sheep in different places, and there was evidence of the presence of distinct strains of it. As it was expected that the vector would be some species of *Culicoides* [*cf. R.A.E.*, B **33** 27], investigations on the taxonomy and biology of the midges of this genus were undertaken, and the senior author co-operated in them by making collections in a light-trap near Sonora. Subcutaneous and intravenous injections into stabled sheep of a broth emulsion of females of *C. variipennis* (Coq.) taken in the trap resulted in the development of clinical blue-tongue on the seventh day. A second similar transmission trial resulted in a febrile reaction from the seventh to the twelfth day. *C. variipennis* was much the most abundant species of *Culicoides* trapped at the time of these tests.

Davis (J. W.). **Studies of the Sheep Mite, *Psorergates ovis*.**—*Amer. J. vet. Res.* **15** no. 55 pp. 255–257, 1 fig., 9 refs. Chicago, Ill., 1954.

Psorergates ovis Womersley, which had not previously been recorded in America, was found on a flock of merino sheep in Ohio in 1951 [*R.A.E.*, B **41** 50], and the flock was maintained so that the mite could be studied. A more satisfactory method than Carter's [**30** 140] of taking skin scrapings to detect its presence was developed and is described. Skin scrapings of 94 animals in the flock showed that 12 of 48 ewes with lambs, four of 25 yearling ewes and one of 11 rams were infested, but ten lambs belonging to seven of the infested ewes were not. There was no relation between infestation and taggy wool. Observations on the stages of the life-cycle were made on the ram and the most heavily infested yearling ewe. The egg, larva, nymph and adults of both sexes were found on the ram but only the egg, nymph and adult female on the ewe. Adults of both sexes, nymphs in three stages, the larva and four stages of egg are figured. Two uninfested merino ewes and one lamb were caged in spring with an infested ewe and her uninfested lamb and examined monthly. Mites were first found on the two ewes in the ninth month.

Heisch (R. B.). **The Host of *Ornithodoros graingeri* Heisch and Guggisberg, 1952.**—*E. Afr. med. J.* **31** no. 1 p. 29, 1 ref. Nairobi, 1954.

Porcupines are apparently the chief hosts of *Ornithodoros graingeri* Heisch & Guggisberg [*R.A.E.*, B **42** 99], as their quills were numerous in the caves on the Kenya coast in which the tick was found and nine out of ten tick blood-meals tested reacted to porcupine antiserum. The tenth was positive for human blood. Larvae and nymphs of *O. graingeri* feed readily on man, and larvae were once found attached to a bat.

Glasgow (J. P.). **The Extermination of Animal Populations by artificial Predation and the Estimation of Populations.**—*J. Anim. Ecol.* **22** no. 1 pp. 32–46, 1 graph, 24 refs. London, 1953.

The term " artificial predation " is here used to denote direct attack on a population of animals by man. It is deemed to include such methods of attack as shooting, hand collection, trapping or the laying down of poison where the animals may find and eat it, but to exclude alteration of the environment or the distribution of poison over an essential part of it. Examples are given from the literature of cases in which artificial predation was successful, in that the prey species was exterminated or almost exterminated, and of a few cases in which it was not. It is shown that theoretically the reduction of a population of a mobile prey by artificial predation would be expected to follow a geometrical progression. Several examples are given from the literature in which this expectation was fulfilled. The examples do not show the disturbances that might be expected owing to the intervention of " control factors " (factors that tend to prevent the further increase of a population when it is dense but have a progressively smaller effect on a diminishing population). This may be because in no case was predation continued to extermination.

In an experiment in which a population of *Glossina palpalis fuscipes* Newst. in riverine forest on the Kuja River in Kenya was subjected to artificial predation by hand-catching [*R.A.E.*, B **39** 189], the geometrical expectation was fulfilled closely. Summing of the geometric series provided estimates of the initial population and the emergence-rate of the fly, which agreed well with independent estimates made by releasing and recapturing marked flies before the start of artificial predation. Immigration, included in the emergence-rate in both methods of estimation, was shown to have a low value that was negligible when the population was large, as at the beginning of the experiment, but was enough to prevent the artificial predation proceeding to extermination.

Glasgow (J. P.) & Wilson (F.). **A Census of the Tsetse-fly *Glossina pallidipes* Austen and of its Host Animals.**—*J. Anim. Ecol.* **22** no. 1 pp. 47–56, 2 figs., 4 refs. London, 1953.

During observations at Nzalagobe, a ridge on the Kenya shore of Lake Victoria, primarily concerned with *Glossina palpalis fuscipes* Newst., high apparent densities of *G. pallidipes* Aust. were noticed in the foot-slope thickets. As possible hosts seemed rather rare, a simultaneous census was made of both species and of hosts. The tsetse population was found to comprise some 5,000 adults of *G. palpalis* and 50,000 of *G. pallidipes*. Daily searching for tracks and tracking of individual animals led to the conclusion that the mean probable population of host animals was 43, of

which 15 were bushpig (*Potamochoerus porcus*) and 13 were bushbuck (*Tragelaphus scriptus*) and the remainder belonged to six kinds of mammals. Thus every animal, on the average, supported 1,163 individuals of *G. pallidipes*. As it is considered probable that *G. pallidipes* would, under local conditions, feed every four days, each animal must feed 291 individuals daily, or two every five minutes throughout a 12-hour day. *G. pallidipes* takes up about 60 mg. blood per feed, so that each animal loses 17·5 gm. blood per day.

Jackson (C. H. N.). **A mixed Population of** *Glossina morsitans* **and** *G. swynnertoni*.—*J. Anim. Ecol.* **22** no. 1 pp. 78–86, 1 fig., 4 refs. London, 1953.

A system of marking is described whereby with the use of nine different colours, applied two at a time on different positions on the dorsal surface of the thorax, 25,000 adults of *Glossina* can be marked without duplication. This obviates the need for re-marking on recapture, when populations are being estimated. The information that can be derived from the observations made by this system can be much increased if releasing and catching stations are disposed evenly along an " angular spiral " path. Observations are described that were made in February, March and April 1951 in an experimental block at an altitude of 4,000 ft. in Tanganyika Territory. The block comprised 0·25 sq. miles of bushland and was surrounded by a wide clearing. The path was 3,800 yards long. *Glossina morsitans* Westw. and *G. swynnertoni* Aust. were common. Very satisfactory agreement was found between estimates of the populations of non-teneral males of these species made by extrapolating from corrected recaptures and without extrapolation from re-recaptures [*cf. R.A.E.*, B **39** 97]. The agreement proves that the catchers do not tend to select the marked flies.

Survival of males of both species in the isolated block appeared short. In the case of *G. swynnertoni*, there was evidence that this was partly because flies were crossing the surrounding clearing, which contained much unburned timber. About a third of the *G. swynnertoni* flying and three-fifths of the *G. morsitans* had been marked. The difference could be explained by the movements of *G. swynnertoni* across the clearing; it was not due to higher activity (availability) of *G. morsitans*, since the availability of this species in the three months was found to be 8·9, 9·7 and 13·3 per cent. while that of *G. swynnertoni* was 7·4, 6·7 and 13·9 per cent. In April, few teneral males and females were caught and hunger was low. *G. swynnertoni* was always less hungry than *G. morsitans*. *G. morsitans* was found mainly in woodland and *G. swynnertoni* in more open bushland. In 12 copulating pairs observed, half the males of each species were mating with females of their own species and half with females of the other.

Burnett (G. F.). **The Effect of Poison Bait Cattle on Populations of** *Glossina morsitans* **Westw. and** *G. swynnertoni* **Aust.**—*Bull. ent. Res.* **45** pt. 3 pp. 411–421, 2 figs., 4 refs. London, 1954.

The following is the author's summary. An experiment was carried out in a small block of mixed bush in Tanganyika Territory in an attempt to eliminate the two resident species of tsetse fly, *Glossina morsitans* Westw. and *G. swynnertoni* Aust., by means of bait cattle treated with DDT. Small cattle were used at the rate of 100 per square mile in herds of 12 or 13 per one-eighth of a square mile. Their numerical superiority over the

large game was no more than about 3:1. The cattle were sprayed twice weekly. Originally a 10 per cent. suspension of the p,p′isomer was prepared from a commercial formulation of DDT. Later a laboratory-prepared emulsion (10 per cent. technical DDT) was used. Extermination was expected with a reduction in numbers of old male tsetse of 99·9 per cent. In practice *G. morsitans* was reduced by 99·5 per cent. and *G. swynnertoni* by 92·5 per cent. It is considered that there was sufficient immigration across the barrier clearing to account for the failure to achieve extermination of either species. It is not possible to say if extermination would have been attained in the absence of immigration. It is considered that with the insecticidal formulations now available there is not much prospect of improving on these results in similar conditions although a great reduction in tsetse numbers is possible and might stop the carrying of disease. In the dry season, after the grass has been burnt, there is better prospect of success.

Laird (M.). **The Mosquitos of Aitutaki, southern Cook Islands.**—*Bull. ent. Res.* **45** pt. 3 pp. 423–427, 1 pl., 12 refs. London, 1954.

Non-periodic filariasis caused by *Wuchereria bancrofti* occurs in the southern Cook Islands, and the vector is *Aëdes polynesiensis* Marks (*pseudoscutellaris*, auct.) [*R.A.E.*, B **40** 34]. This was the only mosquito hitherto recorded from Aitutaki, one of the islands of the group. From 14th to 16th March 1953, 17 larval habitats of all kinds on the island were investigated, and *A. polynesiensis* was collected in eight of them, *Culex pipiens fatigans* Wied. in three and *C. annulirostris* Skuse in nine. *C. annulirostris* was the only species found in irrigation ditches. *A. polynesiensis* was by far the most troublesome mosquito throughout the island at the time. *C. annulirostris* was quite common at night, but adults of *C. p. fatigans* were never seen. The irrigation ditches in which larvae of *C. annulirostris* were found contained various predators, and there was striking evidence of the effectiveness of *Gambusia*, which had been introduced some 20 years earlier, in controlling this mosquito. The breeding places of *C. p. fatigans* and *A. polynesiensis* were mainly water in artificial containers and were free from predators. All three species were found in a beached canoe. Canoes and other vessels are probably responsible for carrying mosquitos from one island to another.

Van den Berghe (L.) & Lambrecht (F. L.). **Notes on the Discovery and Biology of *Glossina brevipalpis* Newst. in the Mosso Region (Urundi).**—*Bull. ent. Res.* **45** pt. 3 pp. 501–505, 2 pls., 9 refs. London, 1954.

The following is the authors' summary. *Glossina brevipalpis* Newst. is recorded for the first time in Ruanda-Urundi, where it has been found in the riverine forest of the upper Malagarasi river in the south-east of the territory. Resting places of both male and female flies have been found to be on tree trunks, between six and twelve feet up, in heavily shaded riverine thickets. The species is clearly crepuscular. It is suggested that the male's habit of resting on paths toward sunset is due to thermotropism rather than to phototropism, or that it may be related to passage of game. Numerous puparia have been found in a late-dry-season breeding ground; these have hatched readily. The animals encountered near the habitat of

G. brevipalpis are hippopotami, wild pigs, crocodiles, monkeys and antelopes. Infections by trypanosomes have been found in proboscis, gut and salivary glands, but experiments on transmission of these trypanosomes from the wild flies to goat, guineapig and rabbit have thus far failed. Research is at present being carried on to determine the nature of the trypanosomes, of which there are probably several.

HAUFE (W. O.). **The Effects of atmospheric Pressure on the Flight Responses of** *Aëdes aegypti* **(L.).**—*Bull. ent. Res.* **45** pt. 3 pp. 507–526, 8 figs., 19 refs. London, 1954.

The following is based on the author's summary of this account of the results of laboratory investigations on the effects of air pressure on flight activity in *Aëdes aegypti* (L.). Pressure changes are an important factor in determining activity, provided that the mosquitos are acclimatised first to a particular pressure level. The period of constant conditions necessary for acclimatisation was between three and six hours for all pressure conditions investigated. Flight activity was about the same at all levels of constant pressure investigated between 550 and 800 mm. mercury. Where acclimatisation was insufficient, activity was random. After complete acclimatisation to a given pressure, a decrease in pressure was more stimulating than an increase if the original pressure was above 735 mm. mercury and less so if it was below. The activity during a uniform rise in pressure from 530 to 730 mm. at 7·7 mm. per minute was at least ten times that during a reverse fall in pressure at the same uniform rate. When the rate of change was not more than 1 mm. per second, the maximum flight activity for falling pressures was observed at 780 mm. and for rising pressures at 735 mm. In the 30 minutes following the change, a pressure change of 15 mm. at about 1 mm. per second was 2·5 times as stimulating as one of 30 mm. at the same rate. At pressures between 530 and 730 mm., lower rates of increasing pressure were more stimulating than higher rates, but higher rates of decreasing pressure were more stimulating than lower ones. For mosquitos that had lived four days after emergence, variability of flight activity between individuals emerging on different days was three times that between individuals emerging on the same day from the same brood.

GLASGOW (J. P.). *Glossina palpalis fuscipes* **Newst. in lake-side and in riverine Forest.**—*Bull. ent. Res.* **45** pt. 3 pp. 563–574, 3 figs., 8 refs. London, 1954.

In 1944, a field station was established in Kenya at the north-east corner of Lake Victoria to investigate possible methods of eradicating *Glossina palpalis fuscipes* Newst. along the lake shore. Sheer clearing of the forest to a depth of about 100 yards (its total width) did not eradicate the fly, which was able to persist in appreciable though reduced numbers in the evergreen thicket behind the original forest. It was evident that if clearing was to be successful, it would have to be carried back some 200–300 yards from the lake. Partial clearing (removal of undergrowth only) was also tried with a view to economy, but was found to be no cheaper and less satisfactory, as rapid regeneration allowed a suitable habitat to develop again within a few months. Observations of general interest made before and during the experiments in the lake-side forest and in riverine forest on the Kuja river are the subject of this paper.

Records of temperature and saturation deficit are given for most months between November 1948 and December 1950 and of rainfall for all months in the years 1946–50. Fly rounds were made on paths cut as near as possible to the edge of the water. Populations of *G. p. fuscipes* were found to show long-term fluctuations that were neither annual nor related to season. On the lake shore, apparent densities (catch of non-teneral males per 10,000 yards) were roughly correlated with the width of the forest, being least where the forest was narrowest. In a block 2,200 yards long by 100 yards wide (the widest studied), where the relation of apparent density to true density was investigated by releasing and recapturing marked flies, the population was estimated at 4,400 non-teneral males. The mean apparent density was 357, so that an apparent density of one implied a population of 176 per square mile, whereas it implies a population of only ten per square mile in the case of *G. morsitans* Westw. or *G. swynnertoni* Aust. [*R.A.E.*, B **42** 149]. Other instances of the low availability of *G. p. fuscipes* in the author's experience are given. However, casual observation indicates high availability, as apparent densities are high and recaptures easy to make. The reason for this anomaly is not understood. It is suggested that it may be misleading to refer to the area occupied by a fly with a linear distribution like *G. p. fuscipes* or to compare its availability with that of *G. morsitans* or *G. swynnertoni*, the habitats of which have breadth as well as length. The mean death-rate of males in the block was 26 per cent. per week, and the mean length of life was 27 days.

Analysis of catches indicated that the flies on the river were always more hungry than those on the lake shore, for the percentages of tenerals, of females, and of males attacking, were all higher on the river. Catches from a boat produced more teneral flies and non-teneral females but fewer non-teneral males than land catches. Carrying a screen increased the catch of females on some occasions, but not on others, the inconsistency being unexplained.

Hocking (K. S.), Yeo (D.) & Anstey (D. G.). **Aircraft Applications of Insecticides in East Africa. VI. Applications of a coarse Aerosol containing DDT to control the Tsetse Flies,** *Glossina morsitans* **Westw.,** *Glossina swynnertoni* **Aust. and** *Glossina pallidipes* **Aust.**—*Bull. ent. Res.* **45** pt. 3 pp. 585–603, 2 figs., 8 refs. London, 1954.

Hocking (K. S.), Burnett (G. F.) & Sell (R. C.). **VII. An Experiment against the Tsetse Flies,** *Glossina morsitans* **Westw. and** *G. swynnertoni* **Aust., in the rainy Season.**—*T.c.* pp. 605–612, 1 pl., 5 refs. **VIII. An Experiment against the Tsetse Fly,** *Glossina swynnertoni* **Aust., in an isolated Area of Thornbush and Thicket.**—*T.c.* pp. 613–622, 1 pl., 1 map, 7 refs.

These three papers, which belong to a series [*cf. R.A.E.*, B **42** 57, etc.], contain accounts of three experiments, carried out in the Central Province of Tanganyika, on the effectiveness against tsetse flies of coarse aerosols applied from aircraft. The solvent for the aerosol solutions was a mixture of equal parts of Shell power kerosene and Shell diesoline, and the solutions were emitted under pressure through fine nozzles fitted to a boom, so that thermal decomposition was avoided and a constant emission rate was obtained. The droplets of the aerosol used in the first experiment had mass median and maximum diameters of about 60 and 200 μ and those of the aerosols used in the second and third had mass median, minimum and maximum diameters of 70, 5 and 250 μ.

The first experiment was on a block of savannah woodland, designated the Galapo Block, in which the flies were *Glossina morsitans* Westw., *G. swynnertoni* Aust. and *G. pallidipes* Aust. The aerosol solution contained 10 per cent. w/v technical DDT, and seven applications were made, each at a nominal dosage of nearly 0·25 lb. DDT per acre. The work was done between the end of September 1950 and early January 1951, and the applications in any particular part of the treated woodland extended over 90 days, or rather more than two pupal periods. The short rains began in November, and many of the trees were in full leaf by the end of the period.

The population of *G. pallidipes* was so drastically reduced that it subsequently died out. The reduction of *G. morsitans* was about 98 per cent. and of *G. swynnertoni* about 95 per cent. The differences between the reductions are attributed mainly to differences between the ease with which the three species can be killed. It is pointed out that this is not necessarily equivalent to differences in susceptibility, but may be associated with such factors as resting or flight habits. Comparisons are made with previous experiments [**42** 24], and the different results obtained are discussed, but no satisfactory explanation of them was found. Increased cover during the leafy period may have reduced the effectiveness of applications made then and the total periods covered by the various series of applications were probably involved. Random effects, leading to ineffective treatments may also be important. Costs are discussed.

The second experiment was designed to test further the equipment and method employed in the first by using them in the season when the bush was in full leaf. The block used was the one that had been treated with DDT in 1949 [**42** 24] and is designated the North Block. It consisted of some 4,000 acres of mixed bush lightly infested by *G. morsitans* and *G. swynnertoni* and was treated seven times between 23rd January to 4th May 1951 with a solution of technical BHC varying in strength from 17·6 to 22·4 per cent. with a mean of 19·4 per cent. (equal to 2·45 per cent. γ isomer). This was dispensed at a nominal mean dose of 0·25 lb. technical BHC per acre per application. The first application was relatively ineffective, and for the second and subsequent cycles the emission rate, which had been below expectation, was increased and the swathe width was reduced over part of the block. Kill was much improved, but neither species of *Glossina* was exterminated. Owing to the number of factors involved, the main reason why this experiment was less successful than previous ones could not be determined, but many of the difficulties encountered are inherent in rainy-season operations in East Africa.

The third experiment was designed to investigate the possibility of achieving eradication in an area where immigration was thought to be highly unlikely. It was carried out on the Atta Bush, an isolated area of 2,200 acres of thicket and thornbush in which the fly was *G. swynnertoni*. The aerosol solution contained a 10 per cent. w/v technical DDT, and it was intended to make eight applications of 0·25 lb. DDT per acre at fortnightly intervals. Delays due to unseasonable bad weather reduced this to seven at a slightly higher rate between 6th November 1951 and 2nd March 1952. The trees were in leaf throughout. The apparent density of *G. swynnertoni* was reduced from about six to zero at the end of the second application. One fly was caught in December after the second application, one in January after the fifth and no more for six months. It is not possible to say whether a few that were caught subsequently were brought in or were the offspring of survivors, as it is known that a vehicle carried tsetse to within a short distance of the block. The experiment was more successful, to a highly significant degree, than that on the Galapo Block, but doubtfully more successful than the first (DDT) treatment of the North Block [**42** 24],

because the increase in population in the latter block may have been assisted by immigration. Its success as compared with the Galapo experiment is attributed to the smaller initial population, though the second (BHC) experiment on the North Block showed that a low population does not in itself ensure success.

NASH (T. A. M.) & PAGE (W. A.). **The Ecology of *Glossina palpalis* in Northern Nigeria.**—*Trans. R. ent. Soc. Lond.* **104** pt. 5 pp. 71–169, 7 pls., 15 figs., 31 refs. London, 1953.

The following is based on the authors' summary. Over a period of six years (1944–50), a population of *Glossina palpalis* (R.-D.) was studied in great detail along 2,400 yards of stream at Katabu, which is about 14 miles from Kaduna and near the northern limit of the range of the fly in Nigeria. The methods used included regular fly-rounds along which all tsetse caught were marked and released, regular puparia-rounds, and the keeping of flies in tubes in different parts of the stream-bed. It was found that the ecoclimate within the fringing forest is far more equable than the general climate of the adjacent woodland savannah. There was no appreciable difference in the wet season between the ecoclimate in a reach where the stream always dried up and that beside permanent pools, but conditions in the late dry season were far less severe near the pools. Differences in the conditions 4 ft. and 4 ins. above ground-level were very slight, except near the pools in the dry season. They were not great even near the pools in the late dry season in mild years, but in severe years, there was a pronounced zone at 4 ins. above wet sand, in which the climate was much less severe than at 4 ft. This zone, which is referred to by the author as the microclimate, provides protection against extremes of high temperature and prolonged exposure to low humidity, and conditions in it remain remarkably constant from year to year. *G. palpalis* tends to concentrate near the microclimate in the dry season, and this ensures the survival of a few individuals. The amount of water found in a stream and therefore the extensiveness of the microclimate vary from year to year. In severe years, when the microclimate is most restricted, concentration is greatest and *G. palpalis* is limited to the neighbourhood of pools that never dry up. Contact between man and fly is close [*R.A.E.*, B **39** 92], and transmission of sleeping sickness [*Trypanosoma gambiense*] is likely to be increased. It is suggested that in such years, the disease may be introduced to adjacent villages by infected flies moving up and down the stream at the start of the dispersal season. In years in which water is abundant and *G. palpalis* is distributed along the streams, there is likely to be little transmission of sleeping sickness, as the fly is not concentrated near water-holes and people visit them less. However, an increased rate of transmission of trypanosomiasis may be expected among nomadic cattle grazing along the stream-bank. The season of long travel by *G. palpalis* starts at the beginning of the heavy rains and lasts for nine months until the weather becomes very hot. It is suggested that most transmission of sleeping sickness takes place in the other three months. Both sexes fly long distances. One marked fly travelled over three miles along a stream and two crossed a mile of woodland to reach another stream system. It is not unusual for flies to cover 2,000 yards in one day.

Duration of life was studied by keeping the flies in tubes in the stream-bed during the critical latter half of the dry season of a severe year. It is concluded that wild flies leave the waterless reaches of a stream at this season because if they did not they would be virtually exterminated. Over

ten-day periods, an average maximum temperature of 88°F. is associated with very high mortality and extermination occurs at 93–95°F. This suggests that the partial clearing of riverine vegetation should be effective in places where the maximum shade temperature may average 95°F. for ten days. Males were seriously affected at lower temperatures than females. Flies that spend their early life in a severe climate can tolerate higher maximum saturation deficits than can others. Flies seem to be least susceptible to severe conditions when 10–50 days old. There is abnormal mortality in the late dry season, even in the microclimate.

On the basis of survival of marked flies, it is estimated that the expectation of life is temporarily high in both sexes at the end of the rains and then falls rapidly to its minimum in the mid-dry season. It becomes greatest at the start of the rains, because the surviving population is young and has some months of favourable conditions ahead. It then falls until the rains begin to abate. Its height at the start of the rains is likely to be important in the spread of sleeping sickness and bovine trypanosomiasis. Its height at the end of the rains is unlikely to be of medical importance, because the wells are full and people do not have to visit water holes, but it may be of veterinary importance, because cattle are passing southwards at the time. The average adult life of wild flies was estimated conservatively to range, according to season, from 6 to 15 weeks for females and from 4 to nearly 8 weeks for males. The percentage of recaptured females known to have lived more than two months sometimes exceeded 50, but that of males never exceeded 7. To obtain data on potential length of life, flies were kept during the dry seasons of two mild years in tubes in the stream-bed by permanent pools. About one-quarter of the flies of each sex died within 20 days of emergence. Very few females died during the next 40 days, about half did so 61–140 days after emergence and the remainder up to the 233rd day. Half the males died within 80 days of emergence, and all within 168. With regard to the extremes of age attainable, females can live up to six months at favourable seasons in nature and almost eight months in captivity; males can live almost five months in nature and 5½ months in captivity. Percentages of females among flies caught and flies bred from wild puparia afforded no evidence that the females were reluctant to come to man or were appreciably less active than males. However, the percentage of females caught was rather higher in the dry weather than in the wet.

Dissection of females showed that breeding continues throughout the year. Reasons are given for supposing that, under certain conditions, a high pregnancy rate may indicate a low reproduction rate, and *vice versa*. The rate of reproduction is believed to be greatly reduced by the low temperatures of much of the dry season. It increases greatly with the high temperatures of the late dry season and early rains. The average monthly temperature of the pupal environment at a depth of half an inch over a period of three years ranged from 65 to 76°F. The mean monthly maximum temperature never exceeded 86·6°F., and the mean minimum never fell below 57°F. The mean temperature was never more than 2°F. lower at a depth of 1½ ins. In the heavy rains, females of *G. palpalis* do not larviposit in the open woodland but do so in scattered sites along higher ground near the junction of the fringing forest and savannah, where the puparia are safe from flooding in normal years. In years of abnormal rainfall, the forest near the source of a stream may prove to be a valuable survival focus. The population of *G. palpalis* decreases from a maximum in the heavy rains, rapidly as the rains cease and then gradually throughout the dry season, to reach its minimum at the beginning of the following wet season. The recovery period that follows extends from May until August

or September. The rapid decrease in the population at the end of the heavy rains is due to reduced length of life associated with the recent occurrence of very low saturation deficits (below 2 mb.), combined with a diminished breeding rate associated with lower mean temperatures (below 73°F.). The gradual decrease throughout the dry season is due to shortened life associated with unfavourably high saturation deficit (above 9 mb.) and a great decrease in the breeding rate associated with the cold dry season. In the late dry season, length of life is further reduced by dangerously high maximum temperatures. The rapid recovery in the first part of the rains is due to exceptionally long life associated with intermediate saturation deficits and the absence of lethal maximum temperatures, combined with a greatly increased breeding rate associated with very high mean temperatures. A study of climatic conditions in the early rains, when all factors combine to promote a great increase in the population of *G. palpalis*, suggests that optimal laboratory conditions are provided by a constant temperature of 77°F. with a relative humidity of 83 per cent. (saturation deficit of 5·3 mb.). Such conditions have proved satisfactory for the large-scale breeding of this tsetse in the laboratory. The results given above, strengthened by observations on the effects of a natural disaster on the fly population, suggest that control operations against *G. palpalis* should be started when the rains are due and the fly population at a minimum and should be continued throughout the recovery season; after this, extermination of any survivors can be left to the natural factors associated with the ensuing reduction period.

Mature trypanosomes of the group of *T. vivax* and of other groups were found in 91 (3·1 per cent.) and 10 of 3,382 males of *G. palpalis* collected over 21 months from streams in the Kaduna-Katabu area, and seasonal infection rates with the *vivax* group are discussed. The rates were lowest in the cold dry season, but the highest ones were not apparently associated with the hottest weather. After the rains have become established, the infection rate in *G. palpalis* increases to reach a peak in the heavy rains, when the oldest flies are found.

G. palpalis can thrive on a diet of baboon, duiker, *Varanus* and possibly monkey blood. The blood of medium and larger species of game is unnecessary. The fly experiences hunger at the height of the rains when the fringing forest is flooded, and this may be a factor contributing to the fall in population at this time.

The requirements for the formation of a permanent habitat are good lateral and vertical insulation provided by evergreen vegetation, and a free flight-line along the stream bed or through the forest to allow travel from dense shelter to the feeding grounds. If the fringing forest is narrow, the presence of permanent pools of water is seasonally essential, and the stream banks must be steep and sharply defined so as to help the vegetation in preventing the dissipation of the microclimate by wind. Favourable temporary habitats contribute to the re-establishment of high densities in the recovery period. Such habitats commonly lack lateral insulation, but have continuous vertical insulation leading to suppressed undergrowth and good visibility and thus providing extensive feeding-grounds during the long-grass season. Small thickets are present and afford temporary breeding sites until the weather becomes too severe. The vegetation is usually of a mixed-deciduous type. The authors' vegetation studies have suggested a new clearing technique against *G. palpalis*, for use where the fringing forest is demarcated by a wall of shrubs and climbers and is roofed over by a canopy composed of the creeper-covered crowns of medium-sized trees. It is proposed that the trees of the canopy should be felled so as to block the stream, but that the shrubs, thickets, creepers and any giant emergents

should be left. This would result in a stream-bed lacking in vertical insulation and choked by low thicket, which should prevent travel by the fly within its ecoclimate. The method, which is called obstructive clearing, should be of value in the savannah belt wherever climber and thicket species are common components of the fringing forest. If successful, it would reduce initial clearing costs and eliminate the need for maintenance. In the forest belt it might prove invaluable under conditions where normal clearing methods could not be contemplated, owing to the rapid rate of regeneration.

Tattersfield (F.), Kerridge (J. R.) & Taylor (J.). **The Effect of repeated Spraying of Insects in increasing their Resistance to Insecticides. I. Development of Resistance to DDT in a Strain of** *Drosophila melanogaster* **Meig.**—*Ann. appl. Biol.* **40** no. 3 pp. 498–522, 8 graphs, 24 refs. London, 1953.

An attempt was made to raise a resistant stock of *Drosophila melanogaster* Mg. by spraying the adults of successive generations with DDT and rearing from the survivors. The original stock was derived from a wild strain and was first acclimatised to laboratory conditions by being reared through several generations by a method similar to one already noticed [*R.A.E.*, B **42** 117]. The adults were lightly anaesthetised before spraying to facilitate handling, and carbon dioxide was at first used for this purpose, but as the flies later became sensitive to this gas [see next abstract], it was replaced by nitrogen. Selection of a strain less susceptible to the insecticide occurred within a few generations among a stock sprayed with 0·01 per cent. DDT, which gave an initial mortality of 93 per cent., but there was no marked selection in a stock sprayed with 0·0075 per cent. DDT, in which initial mortality was only 61 per cent. Resistance fluctuated considerably in all the stocks, whether they are sprayed with DDT at any concentration, or with the carrier alone or were untreated, and there was some indication in the series sprayed with 0·01 and 0·015 per cent. DDT, of a rhythm with peaks of susceptibility occurring every seven generations. Stocks sprayed with 0·01 per cent. DDT showed no lethal effect after 16 months. Comparison of the log-probit dosage-mortality curves for stocks treated over a period of about a year with DDT at 0·01 per cent., at 0·0075 per cent., or at 0·01 per cent. in the earlier generations and 0·015 per cent. in the later ones, or with the carrier alone, showed that the repeated spraying had resulted in a change in slope, which was probably temporary and represented an initial effect due to a change in the distribution of resistance in the stock, and a change in the value of the median lethal concentration. After a further five months, the level of resistance, as demonstrated by log-probit dosage-mortality curves, was the same whether the concentration of DDT remained at 0·01 per cent. throughout or whether it was increased progressively from 0·01 or 0·015 to 0·05 per cent. It is concluded that the higher the initial mortality the more rapid the selection, and that though subsequent increases in the concentration of the toxicant may accelerate the development of resistance, the end-point achieved, as judged by the median lethal concentration, depends apparently upon the content of resistant strains in the initial population.

The rate of respiration in resistant strains was found to be the same as in non-resistant ones in the case of males and greater by an amount that was just significant in females [*cf.* **40** 57]. B. J. Harrison examined the stock selected at 0·01 per cent. DDT and found a higher average number of spermathecae than in the unselected stock.

TATTERSFIELD (F.) & KERRIDGE (J. R.). **The Effect of repeated Spraying of Insects in increasing their Resistance to Insecticides. II. The Effect of Carbon-dioxide Sensitivity on the Toxicity of DDT within a Strain of** *Drosophila melanogaster*.—*Ann. appl. Biol.* **40** no. 3 pp. 523–536, 4 figs., 7 refs. London, 1953.

The following is virtually the authors' summary. During the selection of a stock of *Drosophila melanogaster* Mg. for resistance to DDT, in which carbon dioxide was used for purposes of anaesthesia [see preceding abstract], a sensitivity to this gas developed. The phenomena closely paralleled those shown by the CO_2-sensitive ebony stock isolated by L'Héritier and his co-workers [*cf. R.A.E.*, B **42** 118]. An experimental analysis of its effect upon DDT-sensitivity was made. It was found that a stock selected for CO_2-resistance gave the same probit regression line as the original stock. A CO_2-sensitive stock, whether anaesthetised with nitrogen or carbon dioxide, gave the same regression line at a temperature of 25°C. [77°F.], at which CO_2-sensitivity disappeared, as at 15°C. [59°F.] if adjustment to the proportion of deaths in the control was made. The effect of CO_2 was therefore to limit the population from which selection was made for DDT-resistance, rather than to alter the distribution of DDT-resistance within the stock.

HARRISON (R. A.). **The Fly-spray Testing Method in New Zealand.**—*N. Z. J. Sci. Tech.* **34** (B) no. 6 pp. 457–461, 5 refs. Wellington, N.Z., 1953.

The Peet-Grady method of testing fly-sprays is briefly described [*cf. R.A.E.*, B **37** 89, etc.]. When preliminary tests were made with the method in New Zealand, variable results were obtained. Variation due to differences in the age and sex ratio of the test flies [*Musca domestica* L.] was eliminated by putting all pupae from one culture of flies in a cage for 24 hours when peak emergence was expected, taking the test samples from the flies that emerged, testing them when they were four days old, and using samples of one sex only. When this procedure was introduced, there was no significant difference at the 1 per cent. level between results of tests using fly cultures from the same line. A fresh stock of wild flies was obtained each year, as a line bred continuously in the laboratory changes in its susceptibility to some insecticides. This is illustrated by data from an experiment in which females of one line were sprayed with various concentrations of pyrethrins at intervals over a period of 17 months and the rates of mortality obtained fell as the experiment progressed.

The Peet-Grady test has been criticised on the ground that the dosage used (12 ml. per 216 cu. ft.) is not likely to be equalled in practice with a hand sprayer [**37** 6]. In an attempt to determine a more practical dosage, batches of 25, 50 or 100 flies were introduced into a room of known capacity and treated with a pyrethrum spray applied with a hand-operated discontinuous fly-spray atomiser; the room was then closed for ten minutes after which the flies knocked down were counted. The volume of spray delivered was measured, and Peet-Grady tests were carried out at equivalent dosages. Knockdown in the room tests tended to be higher than in the Peet-Grady chamber, probably because much of the spray was directed at the flies, and the dosage applied was largely determined by the number of flies present. It was concluded that it is impracticable to fix a standard dosage for Peet-Grady tests that would suit all field conditions. The standard Peet-Grady method is thought to be the most suitable one on which to base recommendations for formulations of spray materials. In

making recommendations for New Zealand, it is considered that a knockdown of 95 per cent. and a mortality of 70 per cent. should be required of a spray in Peet-Grady tests.

Scrivani (R. P.), Reeves (W. C.) & Brookman (B.). **Duration of Activity of Western Equine Encephalitis neutralizing Antibodies in** *Aedes nigromaculis* **and** *Culex tarsalis*.—*Amer. J. trop. Med. Hyg.* **2** no. 3 pp. 457–463, 9 refs. Baltimore, Md., 1953.

It is a common practice to inject suspensions of pools of mosquitos into mice in order to find whether any of the mosquitos contain a virus, but it has been suggested that the virus might be neutralised in the suspension by antibodies if some of the mosquitos ground into it had fed on immune blood. To determine how long ingested neutralising antibodies would remain active in mosquitos, females of *Aëdes nigromaculis* (Ludl.) and *Culex tarsalis* Coq. that had fed on sera or whole blood of a man or rabbits immune from western equine encephalitis were kept at 76–85°F., and samples were taken soon after feeding and 24, 48 and 65 hours afterwards, sealed in tubes and stored in a refrigerator for test. Suspensions were then prepared with them and titrated against the virus. The suspension-virus mixtures were kept for one or 24 hours at about 4°C. [39·2°F.] before being inoculated into mice. These periods were chosen to represent the usual laboratory procedure (short test) and to provide a more sensitive test for diluted antibodies (long test). Protection by neutralisation was demonstrated in two of the four short tests and all of the long tests with suspensions of mosquitos sampled soon after feeding (within three hours). Lack of time for virus-antibody combination was shown in two pools prepared immediately after feeding. Except for one instance of demonstrable neutralisation with a 24-hour sample, no protection was shown in mosquito samples taken 24 hours or more after ingestion of immune bodies.

In pools of mosquitos collected in the field, virus would undoubtedly be neutralised to a smaller extent than in these experiments, since not all the mosquitos would have fed on immune hosts and such immune blood as was ingested would probably have a lower titre of neutralising antibodies. Hence, it is unlikely that ingested antibodies would interfere with the isolation of virus from infected mosquitos kept alive at room temperature for about 24 hours before freezing.

Bevier (G.), Torres-Muñoz (N.) & Doria-Medina (J.). **Yellow Fever in Bolivia, its History and Epidemiology.**—*Amer. J. trop. Med. Hyg.* **2** no. 3 pp. 464–482, 4 maps, 6 refs. Baltimore, Md., 1953.

Since the introduction of modern methods of diagnosis and control in 1932, there have been records of 9,635 cases of yellow fever in Bolivia, of which 5,144 occurred in the presence of *Aëdes aegypti* (L.). The last epidemic transmitted by *A. aegypti* was in 1936. The mosquito was eradicated a few years later [*R.A.E.*, B **36** 96], and reinfestations ceased in 1948. Cases of jungle yellow fever occur periodically in five endemic areas, one in the Department of La Paz and four in the Department of Santa Cruz, and there are also isolated cases and small epidemics outside these areas. The disease was widespread and unusually serious in 1935–36 and again in 1949–50, whereas in the interim the incidence in man was much lower. In early 1950, there was an epidemic in the Department of Chuquisaca as well as cases in most of the endemic areas. No cases of jungle yellow fever have ever been recorded in July–October, and epidemics

are almost invariably associated with notably increased populations of mosquitos of the genus *Haemagogus*. The species that have been identified from Bolivia are *H. capricorni* Lutz, *H. uriartei* Shann. & Del Ponte and *H. spegazzinii* Brèthes [**35** 121; **37** 143], and it is expected that *H. s. falco* Kumm, Osorno-Mesa & Boshell-Manrique will also be found there as it occurs in neighbouring parts of Brazil.

Charles (L. J.). **Re-infestation Problems in an *Aedes aegypti*-free Area in British Guiana.**—*W. Ind. med. J.* **2** no. 1 pp. 1–10, 1 pl., 2 figs., 13 refs. Kingston, Jamaica, 1953.

When routine DDT-spraying was adopted as the sole method of controlling mosquito-borne diseases in British Guiana in 1947 [*cf. R.A.E.*, B **37** 41], the treatment was not applied in Georgetown as it had been freed of *Aëdes aegypti* (L.) in 1946 [**39** 72]. However, a barrier of suburbs was sprayed to keep it free of *Anopheles darlingi* Root, the local malaria vector. The DDT treatments in the rural areas protected the town from the risk of the introduction of *Aëdes aegypti* by land transport and inspection of shipping provided a further safeguard, but the auxiliary-motored schooners trading between Georgetown and the islands of the eastern Caribbean remained a potential source of danger because of their unsatisfactory water-storage arrangements. Of 634 schooners examined in 1948–51, 44 were infested. Routine measures adopted against reinfestation from the ships comprised inspection of all arrivals in the Demarara River before they docked and encouragement of the provision of adequately protected water receptacles; spraying of all positive schooners and application of 50 per cent. DDT wettable powder as a larvicide at 4 parts technical DDT per million to all positive receptacles; and routine spraying with DDT of all the schooners twice a year and of the premises in the docks area once a year. Larvae and pupae collected were taken alive to the Mosquito Control Service Office in central Georgetown. In June 1951, a small localised infestation had developed in the town, almost certainly as a result of the escape of three adults from this office late in 1950. It was rapidly eliminated. The situation of the foci relative to the office and to each other conformed to the pattern to be expected with a mosquito with a short flight-range and indicated that widespread infestation would be unlikely to develop in Georgetown as long as annual inspection of unsprayed areas was continued.

Papers noticed by Title only.

Lane (J.). **Neotropical Culicidae. Volume I. Dixinae, Chaoborinae and Culicinae, tribes Anophelini, Toxorhynchitini and Culicini (Genus *Culex* only). Volume II. Tribe Culicini,** *Deinocerites, Uranotaenia, Mansonia, Orthopodomyia, Aedomyia, Aedes, Psorophora, Haemagogus,* **tribe Sabethini,** *Trichoprosopon, Wyeomyia, Phoniomyia, Limatus* **and** *Sabethes*.—1112 pp., 1072 figs., 1 map, many refs. São Paulo, Univ. São Paulo, 1953.

Aitken (T. H. G.). **The Culicidae of Sardinia and Corsica (Diptera).**—*Bull. ent. Res.* **45** pt. 3 pp. 437–494, 2 figs., 4 pp. refs. London, 1954.

Skaife (S. H.). **African Insect Life.**—9½ × 6 ins., viii + 387 pp., 75 pls. (5 col.), 190 figs. Cape Town, London, New York, Longmans Green & Co. [1954.] Price £3 3*s*. [See *R.A.E.*, A **42** 324.]

Memorandum on Measures for the Control of Mosquito Nuisances in Great Britain.—*Med. Mem. Minist. Hlth* no. 238 (revd.), 36 pp., 2 pls., 2 maps, 37 refs. London, H. M. S. O., 1954. Price 1*s.* 3*d.*

The main changes in this edition (revised by Sir G. Covell & P. G. Shute) as compared with two already noticed [*R.A.E.*, B **29** 19; **31** 143] are that the measures recommended for control are brought up to date, some additional information on the bionomics of the mosquitos is included, two additional species of *Culex* (*C. modestus* Fic. and *C. torrentium* Martini) are recorded, and the two British members of the complex of *Anopheles maculipennis* Mg. (*atroparvus* van Thiel and *messeae* Flni.) are dealt with separately.

Stone (A.) & Rosen (L.). **A new Species of *Culex* from the Marquesas Islands and the Larva of *Culex atriceps* Edwards (Diptera: Culicidae).** —*J. Wash. Acad. Sci.* **43** no. 11 pp. 354–358, 3 figs., 2 refs. Washington, D.C., 1953.

Descriptions are given of the larva and reared adults of both sexes of *Culex marquesensis*, sp. n., from the Marquesas Islands and of the hitherto undescribed larva of *C. atriceps* Edw., a related species that is known only from the Society Islands. *C. marquesensis* has been found on five of the six inhabited islands of the Marquesas group, and *Aëdes polynesiensis* Marks and *C. pipiens fatigans* Wied. (*C. quinquefasciatus*, auct.), have now been taken on all six.

Larvae of *C. marquesensis* have been found in rock holes, coconut husks, water drums and barrel tops, and those of *C. atriceps* in tree holes, coconut husks and artificial containers of various kinds. Adults of the former have not been taken in nature. Adults of *C. atriceps* sometimes rest in houses, but are more commonly found in natural resting places. They attack man at night, but seldom do so in considerable numbers. The junior author has shown that occasional females can support complete development of Polynesian strains of *Wuchereria bancrofti*, but it seems unlikely that the species is an important vector in nature.

Woodhill (A. R.). **Experimental Crossing of *Aëdes* (*Stegomyia*) *pseudoscutellaris* Theobald and *Aëdes* (*Stegomyia*) *polynesiensis* Marks (Diptera, Culicidae).**—*Proc. Linn. Soc. N. S. W.* **79** pt. 1–2 pp. 19–20, 3 refs. Sydney, 1954.

Four crossing experiments were made between *Aëdes polynesiensis* Marks from Tahiti [*cf. R.A.E.*, B **41** 161] and *A. pseudoscutellaris* (Theo.), using about 130 females and 150 males in each [*cf.* **40** 106]. The numbers of eggs produced and (in brackets) the percentages that hatched were 1,223 (4·8) and 1,723 (36·6) in the two experiments with *A. polynesiensis* as the female parent and 229 (5·6) and 530 (19·4) in the two with the reciprocal cross. For the control experiment with normal colonies of *A. polynesiensis* and *A. pseudoscutellaris*, the corresponding figures were 6,582 (95·2) and 5,948 (91·8), respectively. The hybrids were bred through to the F_2 generation and behaved normally in every way. F_1 hybrids of one of the crosses were examined by Marks and showed considerable variation, but were mainly intermediate between the parents. A close study of the two mosquitos in Fiji, where crossing might occur in nature, is desirable, but

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the evidence of these experiments is considered to suggest that it might be most accurate to consider them two subspecies of *A. pseudoscutellaris*.

Hamon (J.). **Apparition à la Réunion d'une résistance au DDT chez** *Culex fatigans* **Wiedemann, principal vecteur de la filariose à** *Wuchereria bancrofti* **dans l'île.**—*Bull. Soc. Path. exot.* **46** no. 3 pp. 454–463, 3 graphs, 21 refs. Paris, 1953.

Instances of resistance to DDT in Diptera are reviewed from the literature, and the occurrence in Réunion of resistance in both adults and larvae of *Culex pipiens fatigans* Wied. is recorded. Spraying of interiors of houses with 5 per cent. DDT in kerosene was begun in 1948 and eventually extended to include all parts of the island at an altitude of less than 1,500 ft., and 5 per cent. DDT in diesel oil was used on mosquito breeding places near built-up areas and on the coastal plain from 1950 onwards.

Resistance in adults of *C. p. fatigans* was observed in the treatment season (October–April) of 1950–51 and both repellence and true resistance were found to be involved. There was 53 per cent. survival of females reared from pupae taken in nature and confined for 30 minutes in a treated cage, but when the survivors were exposed again after 48 hours the results were very inconsistent, with survival ranging from 56 to 93 per cent. This was attributed to differences in the duration of treatment in the areas from which the strains had originated. One afternoon in 1951, mosquitos were caught on a wall treated some months earlier and still showing DDT crystals, and were transported to the laboratory under very unfavourable conditions. All the females and 42 per cent. of the males were alive four days later.

Evidence of resistance in larvae was often noticed in 1951, and its intensity was examined experimentally. Larvae from various parts of the island were placed in 400 cc. water in dishes 19 cm. in diameter, and the water was treated with one drop diesel oil containing insecticide and a spreading agent. Results are given for 5 per cent. DDT and 1 per cent. γ BHC. Of a batch from a locality that had received three treatments against adults and very intensive treatments against larvae, 60 per cent. pupated and gave rise to adults, as compared with 68 and 87 per cent. in the case of batches treated with diesel oil only and untreated, respectively. Batches from localities that had received no treatment against larvae and from one in which the treatment had been less intensive did not survive to pupate, though death was considerably retarded in the batch from the treated locality. Larvae of the strain that showed resistance to DDT were slightly resistant to BHC.

It is thought that adult and larval resistance may be distinct, a strain resistant in one stage not necessarily being resistant in the other.

Colless (D. H.). **Observations on the Flight Range of** *A. balabacensis* **Baisas** (= *A. leucosphyrus*, **auct.**).—*Med. J. Malaya* **7** no. 3 pp. 179–184, 2 graphs, 3 refs. Singapore, 1953.

The most important malaria vector in North Borneo, *Anopheles leucosphyrus balabacensis* Baisas (which is here accorded specific status [*cf. R.A.E.*, B **42** 145]) is closely associated with jungle, in which it breeds and rests [*cf.* **36** 203–204]. Its flight-range was therefore estimated by observing the degree of splenic enlargement in children 2–13 years old living at different distances from the jungle and correcting for variations in breeding intensity. It was found that when the number of breeding places

within half-a-mile was taken as 150, a standard of heavy breeding apparently unlikely to be exceeded, splenic enlargement fell to zero when the distance from the jungle was 790 yards. This is suggested as an estimate of the effective flight-range of females crossing open country in search of a blood-meal. Imperfections in the method are discussed, and it is concluded that for practical purposes, it is safe to regard half-a-mile as the effective flight-range.

Dawson (L. S.). **The Effect of DDT on Culicine Larvae.**—*Med. J. Malaya* **8** no. 1 pp. 45–49, 1 ref. Singapore, 1953.

To test the effectiveness of DDT against larvae of *Culex* in polluted water, experiments were carried out in heavily contaminated, brackish, slow-flowing earthen drains in Penang containing larvae believed to be *Culex sitiens* Wied., in the final separation chamber of a septic tank in Singapore containing larvae believed to be *C. pipiens fatigans* Wied., and in densely planted and heavily polluted vegetable ponds in Singapore containing larvae of several species of *Culex*. Emulsions prepared from a concentrate containing 25 per cent. DDT were used. They were applied to the drains and ponds with a knapsack sprayer and to the septic tank with an oiler that gave less even coverage. The dosages of DDT applied per acre were 6·8 and 10·7 oz. in two drains (the latter dosage probably considerably reduced by drift), 3·4 oz. in the septic tank, and 5·2 and 7·3 oz. in the ponds. About half the dosage on the ponds was probably lost by drift and retention by the vegetation. Increasing the dilution of the spray is considered desirable to reduce retention. Counts of larvae before and 24 hours after application showed that the five treatments resulted in total reductions of 98·3, 96·1, 74·6, 62·7 and 56 per cent., respectively. If first-instar larvae, which would have hatched from eggs surviving the treatments, were ignored in the post-treatment counts, the reductions were the same in the drains and 76·9, 89·6 and 96·3 per cent. in the septic tank and ponds.

In contrast with these results, treatment of a vegetable pond with 6 oz. DDT per acre under conditions that were considered far more favourable caused only about 30 per cent. mortality. Laboratory experiments showed that the nature of the pond water was not responsible for the poor result, but rain was falling while the spray was being applied whereas none had fallen in the other tests. As there are strong indications that DDT acts on mosquito larvae mainly as a stomach poison, it is suggested that the rain may have largely prevented feeding during the relatively short period for which the DDT would remain effective in polluted water.

Smithburn (K. C.) & Haddow (A. J.). **Ntaya Virus. A hitherto unknown Agent isolated from Mosquitoes collected in Uganda.**—*Proc. Soc. exp. Biol. Med.* **77** pp. 130–133, 15 refs. New York, N.Y., 1951.

A filterable neurotropic virus, for which the name Ntaya virus is proposed, was isolated in 1943 from mice inoculated intracerebrally with a pool of 1,318 mosquitos caught in the Ntaya swamp in Bwamba County, Uganda. The mosquitos comprised more than 20 species, but 1,284 of them were of the genus *Culex*. The virus was not highly pathogenic or strongly antigenic for rhesus monkeys [*Macaca mulatta*] or highly pathogenic for hamsters. Its pathogenic properties in mice are described. Cross neutralisation tests with 23 other neurotropic viruses, a list of which is given, have indicated that it is not identical with any of them.

Dick (G. W. A.), Kitchen (S. F.) & Haddow (A. J.). **Zika Virus (I). Isolations and serological Specificity.**—*Trans. R. Soc. trop. Med. Hyg.* **46** no. 5 pp. 509–520, 2 graphs, 15 refs. London, 1952. **(II). Pathogenicity and physical Properties.**—*T.c.* pp. 521–534, 1 fig., 7 refs.

The isolation of a filterable virus, named Zika virus, from the Zika Forest in the Entebbe area of Uganda is described in the first paper. It was first isolated in April 1947 from the serum of a pyrexial rhesus monkey [*Macaca mulatta*] caged in the forest canopy and a second time from a batch of *Aëdes africanus* (Theo.) taken in the forest in January 1948. Cross neutralisation tests indicated that it is not related to yellow fever, dengue (Hawaiian strain) or strains of Theiler's mouse encephalomyelitis virus, and neutralisation tests with antisera of 14 other neurotropic viruses gave no evidence of identity with them.

The adaptation of the two strains to mice and signs of infection in mice, in which the virus is highly neurotropic, are described in the second paper. Cotton rats (*Sigmodon hispidus*), guineapigs and rabbits showed no clinical signs of infection after intracerebral inoculation of late-passage mouse-brain virus. Rhesus monkeys and African monkeys (*Cercopithecus*) were inoculated subcutaneously or intracerebrally. Viraemia and the development of antibody were shown by all those tested for them, but the only other indication of infection was a mild pyrexia in one of the African monkeys inoculated intracerebrally. Antibody was found in the serum of one of 15 wild monkeys (*Cercopithecus*) and six of 99 human sera; all the positive sera were from parts of Uganda outside the Zika area. The physical properties of the virus are described.

Dick (G. W. A.) & Haddow (A. J.). **Uganda S Virus. A hitherto unrecorded Virus isolated from Mosquitoes in Uganda. (I). Isolation and Pathogenicity.**—*Trans. R. Soc. trop. Med. Hyg.* **46** no. 6 pp. 600–618, 2 graphs, 8 refs. London, 1952.

An account is given of the pathogenicity and physical properties of an agent designated the Uganda S virus, which was isolated from a pool of 47 individuals of *Aëdes longipalpis* (Grünb.), 17 of *A. ingrami* Edw. and one of *A. natronius* Edw. taken in Bwamba County in 1947. Studies on its immunological relationship to 19 other viruses, and several strains of some of them, a list of which is given, have indicated that it is not identical with any previously described virus. Neutralisation tests revealed antibody to the virus in high titre in 7·7 per cent. of sera from 52 residents of Bwamba and 8·3 per cent. of 36 residents of the West Nile District and in the serum of one of six wild monkeys. The agent was highly neurotropic for mice, but produced no clinical signs of infection in cotton rats (*Sigmodon hispidus*), guineapigs, rabbits or monkeys of various kinds.

Dick (G. W. A.). **Epidemiological Notes on some Viruses isolated in Uganda (Yellow Fever, Rift Valley Fever, Bwamba Fever, West Nile, Mengo, Semliki Forest, Bunyamwera, Ntaya, Uganda S and Zika Viruses).**—*Trans. R. Soc. trop. Med. Hyg.* **47** no. 1 pp. 13–43, 1 map, 1 graph, 91 refs. London, 1953.

Between 1937 and 1947, ten different viruses were isolated at the Yellow Fever Research Institute (now Virus Research Institute), Entebbe, Uganda. Two of them, the viruses of yellow fever and Rift Valley fever, had been studied in considerable detail before their isolation in Uganda. The other eight were all thought to be hitherto undescribed agents, and subsequent

studies confirmed this belief for all except the Mengo encephalomyelitis virus [*R.A.E.*, B **40** 53], which was shown to be related to viruses recovered in the United States and later elsewhere. The remaining seven are the virus of Bwamba fever, West Nile virus [**31** 203], the Semliki forest virus [**34** 87], Bunyamwera virus [**37** 150] and Ntaya, Uganda S and Zika viruses [see three preceding abstracts]. Eight of them (all except West Nile virus and the virus of Bwamba fever) have been isolated from mosquitos. The viruses of yellow fever, Rift Valley fever, Bwamba fever and Mengo encephalomyelitis and West Nile virus have all been isolated from man, and in all cases studied, people from whom any of them were isolated developed specific antibody in high titre during convalescence. The epidemiology of each of the ten viruses is discussed. It appears that Mengo encephalomyelitis is primarily a murine disease and that man and monkeys may become infected by contamination of food with excreta from infected rats. Antibody to the virus of Bwamba fever has been found in high percentages of human sera from various places in Uganda, Kenya, Tanganyika, Northern and Southern Rhodesia and Nigeria. It has also been found in East African monkeys and was much more frequent in species that are definitely arboreal than in those that are not. As almost all monkeys sleep in trees by night in Bwamba, this may indicate transmission by a day-flying insect. Antibody to the Ntaya virus has been found in human sera in various areas of Uganda and Tanganyika.

Reid (J. A.). **Transmission of Filariasis.**—*Trans. R. Soc. trop. Med. Hyg.* **47** no. 1 p. 84. London, 1953.

It was noticed during experiments in Malaya in 1949 that females of *Anopheles* fed on a patient with an average of about 350 microfilariae of *Wuchereria malayi* per 60 cu. mm. blood discharged at least one drop of blood from the tip of the abdomen whilst feeding, whereas females of *Mansonia* (*Mansonioides*), the chief natural vectors of *W. malayi*, discharged a clear serum-like fluid. Drops of the material discharged were therefore examined, and it was found that drops of blood from four females of *Anopheles barbirostris* Wulp contained 1–18 unaltered microfilariae but the clear drops from *M. annulifera* Theo. contained nothing. If this is a regular occurrence, it might have a considerable bearing on transmission through concentration of microfilariae in species voiding clear fluid. The ejection of large drops of clear fluid during feeding would cause a serious underestimate of the size of a blood-meal measured by weighing an insect before and after it fed.

Freer (P. M.). **Observations on the early Fate of the Microfilariae of *Litomosoides carinii* (Travassos, 1919), filarial Parasite of the Cotton Rat, after their Ingestion by the Vector, *Bdellonyssus bacoti* (Hirst, 1913).**—*Ann. trop. Med. Parasit.* **47** no. 1 pp. 13–25, 2 figs., 6 refs. Liverpool, 1953.

An account is given of a quantitative study of the fate of microfilariae of *Litomosoides carinii* in *Bdellonyssus bacoti* (Hirst) within 2–24 hours of their ingestion from a cotton rat [*Sigmodon hispidus*], with records of subsequent infection in mites of the same series. The latter showed that only about 4 per cent. of the ingested microfilariae developed to infective forms. Those that presumably did not included certain microfilariae that were stained with difficulty and could be detected only in smears prepared in a special way. Some of them appeared to be in the epithelial cells of the

gut or in free cells in the gut lumen, but it was not certain whether they penetrated the cells or were ingested by them, or whether the events leading to the loss of normal staining reactions occurred when they were still free or were associated with their inclusion in the cells. Some microfilariae penetrated to the haemocoele within 24 hours of ingestion and a few remained apparently unaltered in the lumen of the gut for six days and then passed to the haemocoele and continued their development.

Heisch (R. B.) & Guggisberg (C. A. W.). **Notes on the Sandflies (*Phlebotomus*) of Kenya.**—*Ann. trop. Med. Parasit.* **47** no. 1 pp. 44–50, 1 map, 13 refs. Liverpool, 1953.

Records are given of 19 species of *Phlebotomus* and the two varieties of *P. bedfordi* Newst. from widely separated parts of Kenya. The places, months and years of capture and number and sex of individuals taken is indicated in each case. Similar data are given for five of them in respect of records from localities in an area near the Omo River in south-western Abyssinia, which is an important endemic focus of visceral leishmaniasis (kala-azar) [*R.A.E.*, B **32** 87]. The commonest and most widely distributed sandflies in Kenya are, in order of prevalence, *P. b. congolensis* Beq. & Walr., *P. b. bedfordi*, *P. schwetzi* Adl., Thdr. & Parr. and *P. clydei* Sinton. The only sandflies known to have bitten man in Kenya are *P. schwetzi* and one recorded as *P. congolensis* which may be either of the varieties of *P. bedfordi*.

The only endemic foci of visceral leishmaniasis definitely known in Kenya are at Saricho and Ngomeni, but the disease is probably more widespread. The only sandfly common to the two Kenya foci and the Abyssinian one was *P. b. congolensis*, but it seems unlikely that it is the vector, as it does not belong to the group of *P. major* Annan [*cf.* **24** 85]. The only member of this group found in Kenya was *P. orientalis* Parr., one female and two males of which were taken at Saricho and none elsewhere; its apparent rarity makes it unlikely to be an important vector. *P. clydei*, which is suspected of being a vector in the Sudan [*cf.* **38** 218, etc.], has a fairly wide distribution in Kenya below 3,500 ft. and was taken at the Saricho and Abyssinian foci.

Lewis (D. J.). **The *Stegomyia* Mosquitoes of the Anglo-Egyptian Sudan.**—*Ann. trop. Med. Parasit.* **47** no. 1 pp. 51–61, 7 figs., 49 refs. Liverpool, 1953.

The following is virtually the author's summary. The known distribution in the Anglo-Egyptian Sudan of *Aëdes aegypti* (L.), *A. metallicus* (Edw.), *A. simpsoni* (Theo.), *A. luteocephalus* (Newst.), *A. africanus* (Theo.), *A. apicoargenteus* (Theo.), *A. unilineatus* (Theo.), and *A. vittatus* (Big.) is described and discussed. The part that several species may play as vectors of yellow fever is considered, and control measures are briefly reviewed.

Gordon (R. M.) & Crewe (W.). **The Deposition of the infective Stage of *Loa loa* by *Chrysops silacea*, and the early Stages of its Migration to the deeper Tissues of the mammalian Host.**—*Ann. trop. Med. Parasit.* **47** no. 1 pp. 74–85, 4 pls., 6 figs., 11 refs. Liverpool, 1953.

The following is virtually the authors' summary. On the basis of investigations in the British Cameroons, an account is given of the escape of infective larvae of *Loa loa* from the arthropod vector, *Chrysops silacea*

Aust., their entry into the mammalian host, and the early stages of their migration to the deeper tissues. It is pointed out that the total life-span of *L. loa* is a long one, and that the various happenings that are the subject of this paper occupy only some 40 minutes. The feeding mechanism of *Chrysops* [*R.A.E.*, B **40** 150] is discussed in relation to the escape of the worms from the feeding fly, and the histology of the lesions produced by the mouth-parts is correlated with the site of entry and route of migration of the invading larvae. It is shown that the infective forms of *L. loa* appear to have no power of penetrating unbroken skin [*loc. cit.*], and that it is probable that only those larvae survive that gain access to the tunnel previously cut in the host's tissues by the feeding fly. Evidence is produced that suggests that, in spite of the great wastage resulting from a proportion of the infective forms being deposited on the skin surface, *C. silacea* must be regarded as an effective vector of *L. loa*, in the sense that there is a great risk of many larvae gaining access to the host's deeper tissues during the course of a single infective bite.

Kershaw (W. E.). **Studies on the Epidemiology of Filariasis in West Africa, with special Reference to the British Cameroons and the Niger Delta. I. Methods of Survey for Infections with** *Loa loa* **and** *Acanthocheilonema perstans*.—*Ann. trop. Med. Parasit.* **44** no. 4 pp. 361–378, 1 graph, 21 refs. Liverpool, 1950. **II. The Influence of Town and Village Evolution and Development on the Incidence of Infections with** *Loa loa* **and** *Acanthocheilonema perstans*.—*Op. cit.* **45** no. 3–4 pp. 261–283, 2 pls., 6 figs., 12 refs. 1951.

Nicholas (W. L.), Kershaw (W. E.), Keay (R. W. J.) & Zahra (A.). **III. The Distribution of** *Culicoides* **spp. biting Man in the Rain-forest, the Forest Fringe and the Mountain Grasslands of the British Cameroons.**—*Op. cit.* **47** no. 1 pp. 95–111, 2 pls., 8 figs., 9 refs. 1953.

In the first paper, attention is drawn to the lack of knowledge on factors influencing the spread of certain arthropod-borne helminths that infect man and to the need for intensive field-work on the underlying mechanism of transmission before conditions are disturbed by the extensive use of chemotherapeutic drugs and synthetic insecticides. Possible methods of assessing the incidence of infection in a population are discussed, and the methods adopted in the investigations in the British Cameroons and the Niger delta made by members of the Department of Entomology and Parasitology of the Liverpool School of Tropical Medicine and of the Loiasis Research Scheme [*R.A.E.*, B **40** 149] for estimating numbers of microfilariae of *Loa loa* and *Acanthocheilonema perstans* in the peripheral blood are described. Little variation was revealed in the numbers of microfilariae of *L. loa* in the peripheral blood during the hours of daylight, when *Chrysops* spp. are feeding in this region [**41** 27]; they were sufficiently dense for a fly to become infected at one meal. There was a similar lack of marked changes in the density of microfilariae of *A. perstans* in the peripheral blood during the dusk and dawn periods when *Culicoides grahamii* Aust. is feeding at Kumba [*cf.* **41** 99; **42** 86], but although most people had circulating microfilariae, it is doubtful whether many had enough to infect every fly at each meal. It has been shown that the concentration of the microfilariae of *L. loa* escaping from the lacerated capillaries and taken up by the feeding *Chrysops* is similar to that occurring in the peripheral blood. It may be that the density of the microfilariae of *A. perstans* taken up by *Culicoides grahamii* is different from that in the peripheral circulation [*cf.* **42** 103].

In the second paper, the three stages of evolution of an organism (radiation, adaptation and fine adjustment or stabilisation) are discussed in relation to the development of the filariae, which have no free existence but depend on a combination of hosts. It is suggested that *Wuchereria bancrofti*, which can develop in mosquitos of several genera with different feeding habits and in dissimilar climates, is in the stage of radiative variation, whereas *L. loa*, with intermediate hosts restricted to a small subgenus of *Chrysops* occurring only in or close to the equatorial rain-forest of Africa, is stabilised in the stage of fine adjustment. An account is given of the local conditions and the rates of infection with *L. loa* and *A. perstans* in villages in the undisturbed rain-forest of the British Cameroons, in schools in different parts of the town of Kumba, and in an artificial village on a rubber estate near Sapele in southern Nigeria. It is concluded that the incidence of *L. loa* is altered from normal in the Sapele village because of selective exposure to *Chrysops* of the male rubber tappers [*cf.* **40** 150] and varies in the schools because of differences in the association of the children with rain-forest and with people who are likely to be a source of infection for the flies.

The distribution of *Culicoides austeni* C., I. & M. and *C. grahamii* Aust. (considered, respectively, to be a proved and a possible vector of *A. perstans* [**42** 103]) and of other species of *Culicoides* that bite man in the British Cameroons is surveyed in the third paper. The survey is based on the results of catches made by fly-boys in 11 localities in the rain-forest zone, four in the mountain-grassland zone and one in the zone of savannah with relict forest. Catches were made at the peak biting times of each species. An attempt is made to correlate the distribution of the adults of the species caught in the different areas with the potential breeding-sites there. The following is based on the authors' summary of the results. The species taken biting in the rain-forest zone were *C. grahamii*, *C. austeni*, *C. inornatipennis* C., I. & M. and *C. fulvithorax* (Aust.), which were widespread. *C. distinctipennis* Aust. was caught only near mangrove swamp. It probably bites man, but was not taken doing so. *C. grahamii* was found at all the places visited in the mountain-grassland zone and was always near streams. Its presence was not correlated with the proximity of any particular type of vegetation. *C. grahamii* and *C. inornatipennis* were the only species found in the zone of savannah with relict forest. The relationship is discussed of the biting densities of each species to their previously recorded breeding-sites. It is concluded that, although *C. grahamii*, *C. austeni*, *C. inornatipennis* and *C. fulvithorax* have all been recorded as breeding in the rotting stems of bananas and plantains [*cf.* **42** 86–87], all are using alternative breeding-sites in the rain-forest zone of the Cameroons. It is suggested that the extensive cultivation of such introduced plants as banana and plantain has probably increased the biting density of *C. austeni* near the villages, though it does not appear to have affected the biting densities of any of the other species found, with the possible exception of *C. fulvithorax*, of which it is suggested (though the available data are scanty) that only a small proportion of the flies normally attack man.

EICHLER (W.). **Die Phänologie der Kontaktintoxikationen im *Drosophila*-Test.** [The Phenology of Contact Intoxication in the *Drosophila* Test.] —*Z. angew. Ent.* **34** pt. 3 pp. 346–356, 20 refs. Berlin, 1953.

A knowledge of the symptoms caused by a contact insecticide is often useful for qualitative analysis and also for assessing the results of tests before the occurrence of death. The author therefore describes and compares the reactions of the test insect, *Drosophila melanogaster* Mg., to

contact with deposits of DDT, BHC, parathion or methyl-parathion, and chlordane (M 410). Four stages in the progress of intoxication are distinguished, the first being the period before the occurrence of any visible effect, the second that of excitation, the third that of exhaustion, when the insects lie on their backs, and the fourth that between the onset of immobility and death. The behaviour of untreated flies is also described for comparison.

Riemschneider (R.). **Literatur zur HCH- und Diën-Gruppe. Liste V.** [Literature on the BHC and Diene Group. List V.]—*Z. angew. Ent.* **34** pt. 3 pp. 405–460. Berlin, 1953.

This supplement to a list already noticed [*R.A.E.*, B **40** 207] contains the titles of about 1,100 works on insecticides of the BHC and diene groups published up to 1st December 1951.

Langenbuch (R.). **Über den Einfluss des Lösungsmittels auf die insektizide Wirkung des Lindans.** [On the Influence of the Solvent on the insecticidal Effect of Lindane.]—*Z. PflKrankh.* **60** pt. 4 pp. 167–181, 7 figs., 19 refs. Ludwigsburg, 1953. (With a Summary in English.)

As previous work by the author showed that γ BHC was less toxic in olive oil than in an aqueous suspension when administered orally to *Periplaneta americana* (L.) or topically to house-flies (*Musca domestica* L.), further experiments were carried out on the influence of solvents on toxicity. In the first, standard amounts of 0·03 per cent. solutions of γ BHC were applied topically to the proboscis and antennae of anaesthetised females of *M. domestica* that were ready to oviposit (since these had been found to be more resistant to insecticides than young females or males), and knockdown was recorded at intervals of 15 minutes for up to 12 hours. Knockdown was complete within two hours when the solvent was ethanol, acetone or glycerol, and not complete in 12 hours when it was benzine, diesel oil, olive oil alone or with acetone (1:1), kerosene, castor oil, Turkey red oil (sulphonated castor oil), a polyoxyethylene-sorbitan ester, or cod-liver oil. When the flies were confined for 12 hours on filter papers impregnated with the solutions, knockdown was complete in 135 minutes or less with acetone, benzine and glycerol and in 225 minutes with diesel oil, and not complete in 12 hours with kerosene, olive oil, cod-liver oil and the sorbitan ester. When 0·015 per cent. solutions were fed to females of *Leptinotarsa decemlineata* (Say) by a sandwich method, acetone and glycerol solutions gave complete knockdown in about two and four hours, and solutions in kerosene, diesel oil, olive oil and sorbitan ester did not do so in 24 hours.

Ethanol, acetone and glycerol are classed as effective solvents, and the others as ineffective. Ethanol and acetone are volatile, and the solutions left minute droplets of BHC on glass that solidified on disturbance without altering their shape. Glycerol, which is not volatile, and the ineffective solvents formed solutions that persisted for considerable periods; even benzine, despite its volatility, did not evaporate completely, but left a fine film that maintained the BHC in solution.

No relation could be found between the effectiveness of the solutions in the non-volatile solvents and the ability of the latter to penetrate a film of beeswax (representing the insect cuticle), glycerol for example not penetrating at all, and miscibility with water was obviously not a factor, since glycerol, which was effective, and Turkey red oil and the sorbitan ester, which were not, are all miscible with it.

The solubility of γ BHC in the non-volatile solvents was then studied; it

was very low (0·06 per cent.) in glycerol, and much higher (1·5–12 per cent.) in the ineffective solvents. According to Nernst's partition law, two non-miscible solvents in contact with each other will dissolve a third substance in proportion to its solubilities in them, so that the concentrations in the two remain in a constant ratio irrespective of actual concentration level. It follows that the concentration obtained in the water phase of the insect (the haemolymph and the organs and tissues, such as the nerves, pervaded by it) varies inversely with the solubility of the insecticide in the solvent, so that a toxic dose may not be received if the insecticide is highly soluble in the solvent. Toxicity increases as the ratio of the concentration used to the saturated concentration rises to unity, and in the first experiment this ratio was 0·0025 for the sorbitan ester, 0·0033 for olive oil and 0·0075 for diesel oil, which gave 22, 30 and 58 per cent. knockdown in 12 hours, respectively, and 0·5 for glycerol, which gave complete knockdown in 1·75 hours. When the concentrations of the various solutions were adjusted to 50 per cent. of saturation, all gave complete knockdown of flies within two hours by topical application. The benzine solution was the most rapid in action, and this is attributed to the formation, as the benzine evaporated, of very fine droplets of BHC that solidified on disturbance. The BHC crystals left by the acetone were coarse and less effective than fine ones.

The applicability of the partition law was further accidentally shown by the finding that the addition of an emulsifier to a half-saturated solution of BHC in glycerol, to improve its wetting properties, reduced its toxicity unless the emulsifier was also half-saturated with BHC.

The partition law applies only to solvents that are not miscible with each other, and the miscibility of glycerol with water might be considered an objection to the application of this law to the case of an insect treated with a glycerol solution. Both pyrethrins and DDT have been shown to penetrate the insect integument chiefly by way of the epicuticle covering the sense organs [*R.A.E.*, A **24** 455; **37** 115], and there is no evidence that γ BHC differs from DDT in this respect, solutions of the two in olive oil proving equally less toxic than solutions in acetone. If this is so, the solution comes into contact, not with the water phase, but with the lipoids of the epicuticle, so that the law still applies.

Yeomans (A. H.) & Van Leeuwen (E. R.). **Insecticide Spray Deposits.** —*Soap & sanit. Chem.* **30** no. 4 pp. 141–143, 3 graphs, 1 ref. New York, N.Y., 1954.

When an atomised spray issues from the nozzle of the sprayer, the droplets move in a stream of air. As this approaches a wall, it is deflected and the smallest droplets are deflected with it. Most of the larger ones are deposited on the wall if the nozzle is held at the correct distance from it, but fall to the floor if the nozzle is too far away, or spatter from the wall if the nozzle is too close. The factors that affect deposition are not clearly understood, and nozzles must therefore be tested individually. In a technique described, particle-size is determined by collecting a spray sample on a slide and measuring by means of a calibrated eyepiece in a microscope, and the proportion deposited is ascertained by comparing the amount applied with the actual amount deposited on a specially designed vertical metal plate, from which the spray is recovered either as natural run-off if the plate is already wet or by means of a squeegee. The nozzles are tested in a stationary position at various distances from the plate and in an atmosphere saturated with the spray, to prevent loss by evaporation. Typical results obtained with three nozzles of different output are given.

Harrison (R. A.). **Toxicity of Pyrethrum to Houseflies.**—*N. Z. J. Sci. Tech.* **35** (B) no. 1 pp. 22–29, 6 refs. Wellington, N.Z., 1953.

In consequence of the development of resistance in house-flies (*Musca domestica* L.) to DDT [*R.A.E.*, B **40** 92] and other synthetic insecticides that leave a toxic deposit, attention in New Zealand has returned to insecticides such as pyrethrum that are used as space sprays. Details and tabulated results are given of large-scale tests of pyrethrum sprays carried out by the modified Peet-Grady method [**42** 158] against flies of a normal line (A) and a DDT-resistant line (G). Tests with females of line A showed that the concentrations (w/v) of total pyrethrins in kerosene needed for 80 and 95 per cent. knockdown were about 0·034 and 0·072 per cent., and those required for 70, 80 and 95 per cent. kill were about 0·25, 0·32 and 0·56 per cent. Female flies were more resistant than males. Males of line G were significantly more resistant at the 5 per cent. level to knockdown by pyrethrum than were males of line A, but mortality of males and knockdown and mortality of females of the two lines were not significantly different. The results of tests with extracts containing pyrethrin I and pyrethrin II in the proportions of 3·11:1 and 1:1·24, respectively, both diluted to a concentration of 0·1 per cent. total pyrethrins in kerosene, were not significantly different in respect of either knockdown or kill. These results do not appear to agree with those of previous workers [**27** 24], but it is pointed out that the latter used a higher concentration when they obtained differences in mortality and that the differences of knockdown were of rate rather than final figures. Tests with allethrin at 0·1 and 0·2 per cent. (w/v) in kerosene showed that it was about as effective for both knockdown and mortality as natural pyrethrins at the same concentrations.

Harrison (R. A.). **Toxicity to Houseflies of Paints containing DDT.**—*N. Z. J. Sci. Tech.* **35** (B) no. 1 pp. 43–44, 2 refs. Wellington, N.Z., 1953.

When the coatings were 1,262 days old, flat oil paints containing 2·5 and 5 per cent. p,p′DDT [*cf. R.A.E.*, B **40** 14] produced 95 and 100 per cent. mortality, respectively, of house-flies (*Musca domestica* L.) of a DDT-susceptible strain exposed for about half an hour. With a similar exposure a few days later, the paints gave only 21 and 48 per cent. mortality of flies of a DDT-resistant strain. Oil-bound water paints containing 1, 2·5 and 5 per cent. p,p′DDT and water paints containing 2, 3, 4 and 5 per cent. p,p′DDT were almost ineffective against DDT-susceptible flies exposed for an hour when the coatings were 188 and 176 days old, respectively.

Crystals of DDT were still visible on the surface of the flat oil paint at the end of the test [*cf. loc. cit.*], but no crystal formation was observed on the other paints, so that such insecticidal action as they have appears to be due entirely to particles of DDT incorporated in the surface layer.

Lachmajerowa (J.). **Warunki zimowania samic** *Anopheles maculipennis atroparvus*. [Conditions of Overwintering of the Females of *A. m. atroparvus*.]—*Bull. Inst. mar. trop. Med. Gdansk* **4** no. 1 pp. 79–96, 1 fig., 3 graphs, 13 refs. Warsaw, 1952. (With Summaries in Russian and English.)

To determine the part played by overwintering females of *Anopheles maculipennis atroparvus* van Thiel in the transmission of malaria in the environs of Danzig, observations on their hibernation quarters and feeding were carried out from December 1950 to the end of April 1951, and their

physiological condition and age were ascertained by dissection of individuals taken weekly in hibernation sites. They overwintered in cowsheds and other places where food-hosts were likely to be available for them, and it was found that they could survive, and feed periodically during the winter, not only in warm quarters with temperatures of 13–17°C. [55·4–62·6°F.] but also in much colder ones in which the temperature was 3–10°C. [37·4–50°F.].

The December population included females that had emerged in summer as well as females that had emerged in autumn. The summer ones had taken blood-meals in the open, and some had oviposited; they were more susceptible to cold than the autumn females, and most of them died in January, when the temperature was lowest. The autumn females did not feed until some time after they had paired and found suitable quarters for the winter. Their tendency to feed varied with temperature and increased as the winter advanced. It appeared that they did not feed at all at temperatures below 5°C. [41°F.] or if the temperature rose above this for only a short period. The ovarian diapause was pronounced at the beginning of the winter, but a slow development of the egg follicles and the ampullae then began. Its rate of progress varied with the temperature and increased with the approach of spring, but the normal co-ordination between blood digestion and ovarian development did not occur until March or April.

In the environs of Danzig, cases of malaria occur in autumn and winter and the winter temperature of many of the houses is 16–20°C. [60·8–68°F.], but winter transmission must be rare because few of the mosquitos enter dwellings in autumn and the required combination of gametocyte carrier, vector and a temperature permitting the mosquito cycle of the malaria parasite can seldom occur. The mosquitos would be more likely to acquire infection in May and June when they have left their winter quarters and more gametocyte carriers are available, so that the July population of very old females that had completed several gonotrophic cycles would be the most dangerous.

Kryński (S.), Kuchta (A.) & Becla (E.). **Badania nad istotą szkodliwego działania krwi świnki morskiej na wesz odzieżową.** [Research on the Nature of the detrimental Action of the Blood of Guineapig on the Clothes Louse.]—*Bull. Inst. mar. trop. Med. Gdansk* **4** no. 1 pp. 97–100. Warsaw, 1952. (Also in Russian and English, pp. 100–107.)

It is well known that clothes lice [*Pediculus humanus humanus* L.] do not live long if they are fed on the blood of a guineapig, and most workers believe that guineapig blood is toxic to them. Cabasso, however, concluded from his experiments [*R.A.E.*, B **37** 219, 220] that the failure of the lice to survive is mainly due to their inability to digest the blood of this host, and that, though some of them die because their intestines are damaged during attempted excretion of the undigested contents, the others survive if their starvation is prevented by feeding them on man. In view of this, a detailed investigation of the question was carried out.

The main experiments were with lice that were 12–16 days old and had been allowed to feed on man once a day for 30 minutes. They were kept at 34°C. [93·2°F.]. They fed readily on a guineapig when confined in contact with its skin for 30 minutes, 24 hours after their last meal, though they usually ingested a smaller amount of blood than they did on man. Of those that were not fed again, about 21 per cent. were dead in 24 hours and all in 48. If the lice were fed on man 24 hours after feeding on a guineapig, about 10 per cent. survived, these being the ones that ingested very little blood from the guineapig. A feed on man after only two hours somewhat

increased the percentage of lice that survived and retarded the death of the others. The human blood diluted the intestinal contents of the lice and caused excretion of the guineapig haemoglobin. More of the lice survived if the period of starvation before the feed on the guineapig was shortened to 12 hours. The periods of survival after feeding on guineapigs were smallest in immature lice, particularly those that were newly hatched, and smaller in older adults than in those that were 12 days old.

Examinations of direct and histological preparations of the intestines of engorged lice showed that the guineapig erythrocytes in them underwent rapid haemolysis and the released haemoglobin formed approximately spherical lumps and simultaneously began to crystallise into trigonal pyramids. The beginning of crystallisation occurred before the louse had completed its feed on the guineapig. The crystals distributed themselves along the intestinal epithelium and in about six hours the whole of the intestinal lumen was filled with them. It was evident that the lethal action of the guineapig blood on the louse was due to mechanical injuries to the walls of the midgut by the crystals, which pressed against the intestinal epithelium and tore it. The formation of the crystals was somewhat retarded in the lice that were fed on man two hours after feeding on the guineapig, but it occurred in all the lice examined except a very few that ingested very little of the guineapig blood.

If the engorged lice were kept at 4°C. [39·2°F.] for 24 hours, their digestive processes were inhibited for this period, but the haemolysis of erythrocytes and formation of crystals proceeded as before when they were returned to a temperature of 34°C. In experiments in which guineapig blood, human blood, or other fluids, were injected into lice by Weigl's method, reddening and death of the lice were always connected with the presence of guineapig erythrocytes, and there was a direct proportion between their concentration and mortality and between the concentration of the guineapig haemoglobin in the intestinal contents of the lice and the size of the crystals.

Jirovec (O.). **Współczesny stan chorób pasożytniczych człowieka w Czechosłowacji.** [The present State of parasitic Diseases of Man in Czechoslovakia.]—*Bull. Inst. mar. trop. Med. Gdansk* **4** no. 1 pp. 109–125. Warsaw, 1952. (With Summaries in Russian and English.)

This survey includes notes on mosquitos and malaria in Moravia and Slovakia. Locally acquired malaria in Moravia is now confined to the south and the environs of Moravska Ostrava; a considerable post-war increase in the incidence of the disease was successfully controlled by the treatment and supervision of patients. The Anophelines present include four members of the complex of *Anopheles maculipennis* Mg. (*typicus*, *messeae* Flni., *atroparvus* van Thiel and *labranchiae* Flni.) and two other species (*A. claviger* (Mg.) and *A. plumbeus* Steph.). The principal vectors, on grounds of their prevalence and distribution in relation to that of the disease, are believed to be *typicus* and *messeae* and not *atroparvus*, which was formerly considered to be of importance. *A. claviger* may be a vector in southern Moravia late in the season.

Malaria is endemic in Slovakia and particularly severe in the eastern part, where the chief vectors are *messeae* and *typicus*, *atroparvus* being very rare. The transmission of malaria in a number of villages was brought to an end in 1950 by spraying the interiors of buildings with DDT in emulsified solution. The deposits remained toxic to Anophelines for 8–12 weeks and similar treatment was effective against several species of *Aëdes* in a locality in Moravia in which they were troublesome.

Lachmajer (J.) [Lachmajerowa (J.)]. **Wiek populacji i ilość pokoleń *Anopheles mac. atroparvus* v. Thiel w okolicy Gdańska w r. 1949/50.** [The Age of the Population and the Number of Generations of *A. maculipennis atroparvus* van Thiel in the Environs of Gdansk in 1949–50.]—*Bull. Inst. mar. trop. Med. Gdansk* **4** no. 2 pp. 209–212. Warsaw, 1952. (With Summaries in Russian and English.)

Mosquitos of the group *Anopheles maculipennis* Mg. were collected near Danzig, where they are very abundant, from May to September 1949, and *atroparvus* van Thiel, *messeae* Fln., and *typicus* represented 76·6, 22·9 and 0·5 per cent. of those identified. The physiological age of the females of *A. m. atroparvus* and, consequently, the seasonal course of its development were estimated from measurements of the ampullae [*cf. R.A.E.*, B **31** 187]. The overwintered females became active in the open in late May, and the July population consisted of old ones that had oviposited several times. Adults of the first (summer) generation appeared in late July and early August, and those of the second (autumn) generation emerged in increasing numbers from the end of August onwards. Emergence continued until November, because cold weather retarded development of the later larvae. Females of the second generation, which do not oviposit in autumn, had become more numerous than those of the summer one in the second half of September. They constituted the bulk of the hibernating population, and very few of the summer females survive the winter [*R.A.E.*, B **42** 171–172].

Kryński (S.) & Radkowiak (J.). **Zasady hodowli *R. prowazeki* metodą Weigla.** [The Principles of the Cultivation of *Rickettsia prowazekii* by Weigl's Method.]—*Bull. Inst. mar. trop. Med. Gdansk* **4** no. 2 pp. 213–227, 5 figs., 1 graph. Warsaw, 1952. (Also in English, pp. 237–244, and, slightly abridged, in Russian, pp. 227–236.)

Detailed information is given from the literature and the authors' own work on the cultivation of *Rickettsia prowazekii* in laboratory-reared clothes lice [*Pediculus humanus humanus* L.] infected by rectal injection. The points discussed are the rearing of the lice, the preparation of suspensions of *R. prowazekii* for infecting them, the technique of the rectal injection, the course of the resulting infection in the lice, the way in which they are kept during the development of the infection in them, the preparation of the lice for dissection, the dissection and grinding of the intestines as the initial step in the production of vaccine, the technique of preparing the intestines for histological examination, the staining of smears, and the cultivation and purification of strains of *R. prowazekii*.

Plague in Colorado and Texas.—*Publ. Hlth Monogr.* no. 6, v + 53 pp., 17 figs., 31 refs. Washington, D.C., 1952.

This publication comprises two papers: **Plague in Colorado,** by D. H. Ecke & C. W. Johnson (pp. 1–37, 11 figs., 19 refs.), and **Rodent Plague in the Texas South Plains 1947–49 with ecological Considerations,** by V. I. Miles, M. J. Wilcomb jr. & J. V. Irons (pp. 39–53, 6 figs., 12 refs.).

An account is given of the work of the Rodent-Plague Investigations Group for Colorado, which was set up in 1948 to study plague in the wild rodents of the State and in their fleas, to estimate the prevalence of rats at Denver (where 40 per cent. of the population is centred) and the flea indices of these rats, and to determine the risk of plague to the human population. Plague was first discovered in Colorado in 1941 and has since

been found in rodents or rodent fleas from eight counties. There has been no proved case in man. During the period of study (September 1948 to September 1949), collections were made of 26 kinds of mammals and seven kinds of birds in 13 counties, and some 40 species of fleas were found on them. The five vegetational habitats involved and the methods, techniques and equipment used are described. A list is given of the mammals taken in numbers sufficient to make them worthy of consideration, with notes on the distribution, habitat and abundance of each, the fleas found on it and its possible importance in the epidemiology of plague. A list is also given of the flea species met with, with records of the counties in which each was found and the hosts on which it was taken or with which it was associated, and notes from the literature on its host preference and, if known, its importance in relation to plague.

Sylvatic plague in Park County, in the mountainous central part of the State, is discussed from the first observations in 1945 to the end of the study period in 1949, when two foci had been discovered by the group. Plague-positive findings since 1947 are given. Prairie dogs (*Cynomys gunnisoni*) and ground squirrels (*Citellus richardsonii elegans*) were shown to be the reservoirs. The commonest flea on *Cynomys gunnisoni* in the first focus and probably the most important was *Opisocrostis tuberculatus cynomuris* Jellison. A pool comprising 41 individuals of this flea and four of *Hystrichopsylla gigas dippiei* Roths. was plague-positive. In the second focus, *Cynomys gunnisoni* was the most important rodent involved and *Citellus r. elegans* was concerned to a smaller degree. *O. t. cynomuris* was again the most plentiful flea on the former and composed the whole of one plague-positive pool from it and was predominant in the other two, both of which also contained *Oropsylla idahoensis* (Baker) and *Opisocrostis labis* (J. & R.). *O. labis* was the commonest flea on the ground squirrel. It was probably mainly responsible for spreading plague from one host to the other, and with *O. t. tuberculatus* (Baker) was probably responsible for spread among the ground squirrels. A positive pool of five individuals of *Foxella ignota* (Baker) was obtained from the only example of *Thomomys talpoides* collected. *Thomomys* was not particularly susceptible, as large numbers remained active throughout the epizootic. Evidence is given that *O. labis* can carry plague for at least two months after the death of the host, but *O. t. cynomuris* soon disappeared when hosts died and, though it could spread plague rapidly in an active colony of prairie dogs, did not maintain infection long in their absence. It seems that it is primarily a fur flea, whereas *O. labis* is primarily a nest flea. An epizootic believed but not proved to be plague, observed in Logan and Weld Counties in the rolling prairie of the north-east is discussed. No parasite of mammals was found on a limited number of predacious or scavenging birds examined, but rodent fleas were collected from badgers (*Taxidea taxus*) in Park County and coyotes in other counties, and it is believed that predacious mammals play a significant part in spreading such fleas. There was evidence that the influence of man in the spread of sylvatic plague has been important, as ranchers are known to have released diseased rodents obtained from a distance in colonies of prairie dogs, and are reliably reported to have effectively controlled the prairie dogs as a result.

Rattus norvegicus was distributed over the whole of Denver to some extent, and was the only species of the genus found there. In a small part of the business area, it was heavily infested with *Xenopsylla cheopis* (Roths.), for which a favourable artificial habitat was provided by an abandoned central-heating system. *X. cheopis* was absent from the rest of the town. Four kinds of sylvan rodents were present in Denver and two of them (*Peromyscus* and *Microtus*) came into close contact with the rats, but

there was no evidence of exchange of fleas. It is thought that the only natural way in which plague could reach the flea-infested urban rats would be through the *Microtus* and *Peromyscus* populations along the river. Even if this happened, an epizootic in *Rattus* would probably run its course without affecting the human population, as most of the infested rats are below the street level and people seldom come in direct contact with them. In the poorer sections of the town, where the rodents live in closer association with man, *X. cheopis* is practically absent. A further survey was made to examine the possibility that plague might enter the city through rural rat populations. These populations were relatively small, the only flea found on the rats was *Nosopsyllus fasciatus* (Bosc), and its distribution was discontinuous. It is thought that the wild rodents that surround the town in varying degrees are a greater danger than the rural domestic rats, and also that man would be more likely to be infected with plague by direct contact with wild rodents than by the bites of their fleas, as these fleas seemed very reluctant to attack man even when collected from areas from which the rodent hosts had long since gone.

The following is largely based on the authors' summary of the second paper. Nine counties in western Texas were surveyed continuously for two years (July 1947 to June 1949) to ascertain the extent of sylvatic plague, its means of spread and the danger of its being transmitted to man. The area, its vegetation and fauna are described. Fleas from over 15,000 wild rodents and 1,426 domestic rats and from burrows of prairie dogs (*Cynomys ludovicianus*) and nesting material of pack rats (*Neotoma micropus*) were tested for plague by animal inoculation. Plague bacilli were recovered in four of the counties from 22 lots of fleas and rodent tissue. Pack rats and their fleas, principally *Orchopeas sexdentatus* (Baker), formed a large majority of the positive samples. The greatest abundance of *O. sexdentatus* coincided with that of plague. One lot of *Anomiopsyllus hiemalis* Eads & Menzies collected from pack-rat nests in January was infected. This flea decreases in abundance before plague reaches its peak, but may be important in the overwintering of infection. Three pools of *Monopsyllus exilis* (Jordan) from grasshopper mice (*Onychomys leucogaster*) were infected. Although *Echidnophaga gallinacea* (Westw.) and *Pulex irritans* L. were common on *Cynomys*, plague was identified only from one pool of *Opisocrostis hirsutus* (Baker) from this rodent and from one pool comprising 35 examples of *O. hirsutus* with one of *P. irritans* from one of its burrows. *E. gallinacea* was the most abundant flea collected and occurred on all species of rodents, but was least plentiful in spring and early summer when plague was most often recorded. It was represented in some positive pools of mixed fleas from pack rats.

Plague was readily recovered during epizootics, but was difficult to detect in places where no dying-off of rodents was evident. The nature of its spread was not discovered. Infection was widespread over the area studied and the disease apparently recurred repeatedly within small areas. Prairie dogs were affected in large uncultivated areas but not in small natural areas protected by extensive cultivated land. This indicates that predators do not play any important part in spreading plague, and that the smaller rodents with a limited home range are the principal agents of spread. No plague bacilli were recovered from domestic rats or their fleas. *X. cheopis* was rare in the area surveyed, although *R. norvegicus* was heavily infested with it on a few premises. The introduction of plague into domestic rats from sylvatic rodents is probably uncommon but could occur. Such introduction into a population of rats heavily infested with *X. cheopis* would result in a sharp, highly localised epizootic that would tend to be self-limiting but might cause human cases before dying out.

Lachmajerowa (J.). **Naturalne środowiska kleszcza** *Ixodes ricinus* **L. w województwie Gdańskim.** [Natural Habitats of the Tick *I. ricinus* in the Province of Gdansk.]—*Bull. Inst. mar. trop. Med. Gdansk* **4** no. 4 pp. 409–422, 3 graphs, 9 refs. Warsaw, 1952. (With Summaries in Russian and English.)

Some 6,000 adults and nymphs of *Ixodes ricinus* (L.), as well as larvae, were collected from cattle or by blanket-dragging in pastures in and near forests in the Province of Danzig. The collections were made weekly between 20th May and 7th July 1950 and between 18th May and 24th August 1951, and no other tick was found. The distribution of the ticks in the pastures was irregular; they were most numerous in shady deciduous and mixed forests with a thick undergrowth of shrubs and damp substratum, and also common in damp pastures with marshy vegetation and shaded by coppices of alder and birch. Most of the ticks on the cattle were adult females, and the infestation was highest in May and to a less extent in June, which coincided with the maximum frequency of piroplasmosis in the cattle. The ticks in the rough and thick vegetation of mid-forest were most active during summer, particularly in July. It appeared that the activity of the ticks was affected by the temperature of the air in that their numbers on cattle decreased from June onwards as the temperature rose, and that relative humidity affected their survival but not their activity.

Sergent (Ed.). **La thimni, myiase oculo-nasale de l'homme causée par l'oestre du mouton.**—*Arch. Inst. Pasteur Algér.* **30** no. 4 pp. 319–361, 10 figs., refs. Algiers, 1952.

Basu (B. C.), Balarama Menon (P.) & Sen Gupta (C. M.). **Cases of Myiasis in Man due to** *Oestrus ovis* **Linnaeus (Sheep Bot).**—*Indian med. Gaz.* **88** no. 6 pp. 321–322, 3 refs. Calcutta, 1953.

The first paper is a comprehensive review of knowledge gained during the past 50 years on the distribution and frequency of infestation of the eyes, nose and throat of man by the larvae of *Oestrus ovis* L., with brief notes on its effects and the circumstances in which it occurs. It was first recorded by the author and Etienne Sergent in 1907, soon after it had been observed that the shepherds in mountainous parts of Algeria often suffered from inflammation of the eyes, and occasionally of the nose and throat, as a result of it. Symptoms of the infestation are fairly severe and last 3–10 days, but recovery is spontaneous, the larvae never developing beyond the first instar. Larvae in the nose or throat can be made to release their hold by smoking or chewing tobacco, and those in the eye can be removed with forceps or a blunt curette after the conjunctiva has been anaesthetised with 3 per cent. cocaine. Dogs are also attacked, and the symptoms in them are the same as in man. On the basis of personal investigations in Algeria, a search of the literature and replies received to a questionnaire widely distributed among ophthalmologists in sheep-rearing countries, the distribution of the infestation in Algeria is reviewed in detail and records of its occurrence in various countries and evidence of its absence from others are given. It is concluded that it is common where the number of sheep is small and the human population large but is unknown where the ratio of sheep to man is high. The adult and larva of *O. ovis* are described in an appendix.

In the second paper, it is recorded that four prisoners employed in a wool factory at a gaol in the United Provinces, India, were struck on the nostrils by flies, one of which was caught and identified as *O. ovis*. The symptoms of each case are described. They lasted 3–7 days.

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Mackie (T. T.), Hunter III (G. W.) & Worth (C. B.). **A Manual of tropical Medicine.**—2nd edn., 9½ × 6 ins., xxii + 907 pp., 304 figs. (7 col.). Philadelphia, Pa. & London, W. B. Saunders Co., 1954. Price £3.

The first edition of this manual has already been noticed [*R.A.E.*, B **33** 102]. This second edition is similar in scope and arrangement, but much of the matter in the first has been revised or rewritten to bring it up to date, notes on recently recognised agents of disease are included in the appropriate sections, and a section on molluscs of medical importance is added.

Coutinho (J. O.) & Nussenzweig (V.). **Infecção experimental de triatomíneos pelo *Trypanosoma rangeli* Tejera, 1920.** [Experimental Infection of Triatomines by *T. rangeli*.]—*Folia clin. biol.* **18** (1952), no. 3 pp. 181–188, 10 figs., 18 refs. São Paulo, 1953.

Trypanosoma rangeli [*R.A.E.*, B **8** 183] has been recorded in Guatemala, Colombia, Venezuela, Chile and Argentina [*cf.* also **42** 87], almost always in or associated with *Rhodnius prolixus* Stål and occasionally in man. Species of *Triatoma* have been infected experimentally. The behaviour of a human strain sent to the authors by Pifano from Caracas was studied in São Paulo, Brazil, in various local species of bugs. Injection of the trypanosome into the body cavity of the bugs was suggested by Pifano as an easy way of keeping the strain in the laboratory. The method used to do this is described. All of seven nymphs of *R. prolixus*, 16 of *T. infestans* (Klug) and 15 of *T. vitticeps* (Stål) became infected when inoculated in this way, but none of nine of *Panstrongylus megistus* (Burm.). The degree of infection in the infected bugs varied but was generally intense. Their faeces remained negative, indicating that there was no passage from the body cavity into the intestinal tract. A few samples of saliva obtained by pressure were also negative. Both free and intracellular forms of flagellates were found in the haemolymph. Details are given of the appearance of the latter. When bugs were given an *in vitro* feed on human blood containing cultures of *Trypanosoma rangeli*, three out of eight nymphs of *R. prolixus*, two out of five of *Triatoma infestans*, five out of nine of *T. vitticeps* and one out of ten of *P. megistus* became infected, but none developed infection of the haemolymph. Not all the nymphs of any species fed. Day-old white mice and dogs about a month old inoculated intraperitoneally and subcutaneously with material from the hind-gut of the infected bugs became infected and showed flagellates in their peripheral blood. Ten Triatomine nymphs inoculated in the body cavity with the same material had contracted intense infection six days later. These observations show that inoculation into the body cavity of Triatomines of material suspected of infection with *Trypanosoma rangeli* can be a useful aid to identification. Though *T. cruzi* can also develop in the body cavity of Triatomines, as the authors confirmed, the differential diagnosis of the two species is easy under these conditions.

Budnik (V. S.). **Epizootological Importance of the Parasite Carriers in the Incidence of Piroplasmosis of Horses.** [*In Russian.*]—*Veterinariya* **30** no. 3 pp. 27–34, 1 graph. Moscow, 1953.

A detailed account is given of experiments carried out at Saratov in 1949–51 to determine the period during which a horse infected with *Piroplasma caballi* is infective to *Dermacentor marginatus* (Sulz.), and how long the piroplasm can persist in ticks fed on non-susceptible hosts. The first question was investigated mainly by feeding uninfected adults of *D.*

marginatus on horses that had been infected by ticks of the same species and then ascertaining whether they had become infected by examining their eggs and allowing their offspring to feed as adults on healthy horses. It is concluded that the horses were not infective during the incubation period of the disease, but were infective during its clinical course and subsequently for 80–90 days if they had not been treated with drugs, or for longer if they had. The effect of treatment with the most effective of several drugs was to render the horses non-infective for a period of 40–50 days. When the ticks were fed on infected horses not treated with drugs, the percentages that became infected were low (15–20) during the clinical course of the disease, when the piroplasms were the most numerous in the blood, and then increased, reaching a maximum of 70–78 some 60 days after the cessation of symptoms, when they were less numerous. It fell to the initial level towards the end of the third month, and ticks that fed later remained uninfected.

In the experiments on the persistence of the piroplasm in the tick, batches of F_1 adults reared from initially infected females were divided into groups and these were fed as adults on horses or on non-susceptible animals (rabbits and sheep). Examination of their eggs or tests with their offspring showed that the piroplasm had persisted in the ticks fed on the horses, whereas all, or most, of the ticks in the other groups had become free from it. Another test showed that infected ticks did not lose their infection as a result of feeding on the blood of a horse that was immune following previous infection.

Gladenko (I. N.) & Fortushnyĭ (V. A.). **The Control of Blood-sucking Diptera by the Method of Aviodusting the Biotopes with contact Poisons.** [*In Russian.*]—*Veterinariya* **30** no. 3 pp. 37–40. Moscow, 1953.

The experiments described were carried out in July 1949 and June–July 1950 in an area of about 12 sq. miles in the region of the Dnieper reed-beds to test the possibility of controlling blood-sucking Diptera (mosquitos, Tabanids and Ceratopogonids) by dusting their shelters and breeding places from an aeroplane. The plots selected included pools, swamps and areas covered with reeds, shrubs or trees, and the results were estimated by daily counts of the Diptera that settled on horses in neighbouring meadows and by catches of mosquitos in or near the vegetation. The dusts used contained 6 or 10 per cent. DDT or 12 per cent. BHC.

DDT in talc was used in 1949, and as a preliminary test showed that a rate of 4·5 lb. dust per acre was insufficient to give satisfactory coverage of vegetation, though it was sufficient for water surfaces, rates of 9 and 18 lb. per acre were used. The dust adhered well to the foliage when applied at 9 lb. per acre in the early morning to plants wet with dew and was not washed off by light rain. The results showed that the numbers of Diptera were greatly reduced for four days after dusting and then increased again. When the treatment was repeated, the reduction of Tabanids was still greater and they did not increase again during the observations.

In 1950, BHC was tested in addition to DDT. Clay was used as the carrier, and adhesion to the foliage was less good. DDT dust at 9 lb. per acre caused sharp reductions in population of Diptera and there was no increase for ten days. A second treatment at 18 lb. per acre reduced Tabanids to a minimum, and few were observed throughout the rest of the period. Mosquitos almost disappeared for 4–5 days after treatment with 10 per cent. DDT at 18 lb. per acre and then became as numerous as before. BHC gave analogous results; the numbers of Diptera were greatly reduced

for five days after dusting at 9 lb. per acre, and Tabanids were almost eliminated for ten days when the rate was 18 lb. per acre. Treatment of water surfaces with less concentrated dusts at rates giving about 3·6–4·3 oz. actual DDT or BHC per acre killed Anopheline larvae, and both chemicals at 4·3 oz. also killed the larvae of other mosquitos. First-instar larvae were observed after treatment on a few occasions, owing to sinking of the dust before they hatched. Treatments at much higher rates were shown to be harmless to fish.

PETUNIN (F. A.). **Mechanisation of Treatments of Cattle against Ticks with the Help of a DUK.** [*In Russian.*]—*Veterinariya* **30** no. 6 pp. 57–58, 1 fig. Moscow, 1953.

A 4 per cent. solution of BHC in solar oil, applied as an aerosol, and a solution of sodium arsenite (0·16 per cent. As_2O_3), applied as a wash from hoses, were tested for the control of *Boophilus* on cattle on a farm in Krasnodar on which some of the animals were infected with piroplasmosis. The treatments were applied weekly from 30th July to 10th October, each to 100 cattle, and the applications were made from a motor truck (DUK), on which the aerosol generator or the tank for the arsenite solution was mounted.

The cattle were treated with the aerosol in groups of 20 in a pen just large enough to hold them, and about 1 gal. solution was applied to each group while the truck was driven slowly round the pen to ensure even treatment. The process took about five minutes, and two men changed the cattle in the pen in about the same time. The wash was applied from a pair of hoses connected to the tank on the truck so that the animals were thoroughly wetted. The 100 cattle were treated in about an hour with 110 gals. solution; they were in an enclosure and were not tethered. Both treatments kept the cattle completely free from *Boophilus* and from infection with piroplasmosis for the whole period during which they were applied, and it was observed that the first application of the aerosol killed all ticks of this genus present on the animals. A very few ticks of the genus *Ixodes* were found on the underparts of some of the aerosol-treated animals. The aerosol caused no harm to the cattle except for a temporary irritation of the eyes.

The use of the motor truck and of group treatment required far less time and labour than the usual methods of treating cattle individually, and is considered of particular promise for the protection of cattle that are driven across territory in which piroplasmosis occurs.

BERZINA (A. N.). **Attack by Simuliids on Man in Nature.** [*In Russian.*] —*Parazit. Sborn.* **15** pp. 353–385, 6 figs., 26 refs. Moscow, 1953.

The effect of meteorological factors on the aggressiveness of Simuliids was studied in June–August in 1946 and 1947 at a point on the left bank of the Pechora, in the Arctic region of the Soviet Union [*cf. R.A.E.*, B **42** 46], and in May–September in 1950 and 1951 in the Volga delta, to the south of Astrakhan, and a detailed account of the results is given. The Simuliids seeking to attack man were collected at various times of the day and night under a bell-shaped cover [*cf. loc. cit.*]; they constituted 15 per cent. of all the blood-sucking Diptera thus caught in the Arctic and 6 per cent. of those taken in the Volga delta. Only one species, *Simulium erythrocephalum* (Deg.), was taken in the delta (except for a single example of

S. maculatum (Mg.)), as compared with nine in the Arctic, of which *S. ornatum* Mg., *S. pusillum* Fries and *S. venustum* Say were the most numerous. In the Volga region, where unpublished observations indicate that Simuliids have at least three generations a year, maximum flight occurred in spring and autumn. In the Arctic, the Simuliids were more abundant at the beginning of the flight period about the end of June and again about the beginning of August than they were in the intervening period or later, and this is attributed to two waves of emergence, as it is thought that there was only one generation a year. Of the Simuliids taken during the first wave, *S. ornatum*, *S. venustum* and *S. pusillum*, respectively, constituted 76·9, 13·6 and 3·8 per cent. in 1946 and 0·6, 60·1 and 28·7 per cent. in 1947. In the second wave, *S. pusillum* formed 77·7 and 75·6 per cent. in the two years and *S. venustum* 19·2 and 20·8 per cent. This indicated that the spring and summer populations had different origins, the Simuliids of the first wave possibly resulting from larvae that had been carried by flood waters from the upper parts of the river or its tributaries, and those of the second being of local origin.

Temperature was one of the chief factors regulating the intensity of attack, which was greatest at 15–27°C. [59–80·6°F.] in the Volga delta and 12–27°C. [53·6–80·6°F.] in the Arctic. The lowest temperature at which attack occurred was 6°C. [42·8°F.] in the Arctic and 9°C. [48·2°F.] in the delta, and the highest was 29·9°C. [85·82°F.] in both areas though this was not the highest temperature during the observations in either of them. The temperature limits within which Simuliids attacked, and the lower threshold of their activity, varied with season. Reaction to temperature also varied with species, maximum activity beginning at 12°C. for *S. pusillum* and 15°C. [59°F.] for *S. venustum*.

Light had a marked effect on activity, provided that temperature was suitable, and no flight took place during darkness. In the Arctic, activity continued throughout the 24 hours during the period when the sun did not set and the light intensity did not drop below 25 lux; it was highest at 6,000–10,000 lux, though greater intensities had only a slight deterrent effect. When the nights became dark, the lowest light intensity at which attack began was 10 lux, and maximum attack occurred at 3,000–6,000 lux. Differences in the reaction of the different species to light intensity are described. *S. venustum* required the highest intensity, attacks by it not becoming numerous until 500 lux was reached. In the Volga delta, activity began at an intensity of less than one lux, and was greatest at 1,000–3,000 lux. It was reduced by further increase of illumination, fell sharply at 25,000 lux and ceased completely during the brightest period of the day.

Wind had little effect on activity in the Volga delta, flight coinciding with the windiest time of day, but it reduced the height above the ground at which flight occurred in the Arctic, depressing activity at unfavourable temperatures and stimulating it at optimum temperatures. Relative humidity had no effect.

The daily rhythm of activity, which is described, resulted from the combined effects of temperature and intensity of light.

Breev (K. A.) & Karazeeva (Z. F.). **Materials relating to the Biology of the Warble-Fly of Reindeer** *Oedemagena tarandi* **L. 2. Observations on Larvae of the second and third Instars.** [*In Russian.*]—*Parazit. Sborn.* **15** pp. 410–424, 2 figs., 16 refs. Moscow, 1953.

Observations in 1937–39 and 1950–51 on *Hypoderma* (*Oedemagena*) *tarandi* (L.) infesting reindeer in the north-western part of the Soviet Union

[*cf. R.A.E.*, B **34** 111, etc.] confirmed that the larvae spend ten months in the body of the host [**23** 52], of which three are occupied by the first instar [**42** 69] and 3–4 each by the second and third instars. The warbles appear at the time of the first moult, which usually takes place between 5th and 15th October, but it is delayed in some years by up to a fortnight, and the date is of importance in deciding the best time for slaughtering, so as to obtain hides of high quality. It depends mainly on the oviposition period. The observations showed that the larvae usually abandoned their hosts between the end of April and the beginning of July. Their rate of development was not affected by their position on the body of the host, its sex or the temperature and humidity of the air, but it was somewhat more rapid in animals 1–2 years old than in adults. The main factor was again the oviposition period, and it is concluded that when the weather in July and August is warm and settled and flight ceases in the second half of August, the bulk of the larvae will abandon their hosts between mid-May and mid-June in the following year, whereas if the flight is protracted by fluctuating weather in summer and a warm autumn, this period will be considerably extended. The best time to squeeze the larvae out of the warbles as a control measure would therefore be between 10th and 20th May in the first case and 15–20 days later in the second.

The fully developed larvae seldom died in the warbles, and those that did so occurred chiefly in emaciated animals. On the whole, healthy and well nourished animals were least infested. The intensity of infestation of the two sexes was equal when the animals were one year old, but increased with age in males and decreased in females. It is therefore suggested that the sex and age of animals selected for sampling the intensity of infestation of a herd, should be proportionate to those of the herd as a whole.

Benda (R.) & Gaĭberger [Heyberger] (K.). **The Isolation of *Pasteurella tularensis* from blood-engorged Ticks, *Ixodes ricinus* L.** [*In Russian.*] —*Čsl. Biol.* (Russ. edn.) **2** no. 6 pp. 380–384, 6 refs. Prague, 1953. (With a Summary in German.)

Numerous cases of tularaemia in man and an epizootic in hares occurred in southern Moravia in 1936, and sporadic cases have been observed since. Investigations of its epidemiology there have only recently been begun, but three strains of the bacteria were isolated from ticks in 1953, two from engorged females of *Ixodes ricinus* (L.) taken on hares and one from a mixed batch of *I. ricinus* and *Dermacentor pictus* (Herm.) taken on a dog. The two strains isolated from the ticks from the hares were very virulent to mice, more so than was a strain isolated from man, and were much more virulent when inoculated intracerebrally than when inoculated subcutaneously. Penicillin and streptomycin were tested against one of them and had no substantial effect on it.

Heisch (R. B.). **First Record of *Argas reflexus* (Fabricius) Latreille, 1796 from East Africa.**—*E. Afr. med. J.* **31** no. 3 pp. 89–91, 3 figs., 3 refs. Nairobi, 1954.

In December 1952, an unengorged female of *Argas reflexus* (F.) was found on the clothes of an African woman in a house at Kajiado, Kenya. It is believed that this tick, which infests pigeons, has not previously been recorded in Africa south of the Sahara. The effects of its bite on man can be severe. There was no evidence that pigeons were nesting in the house.

Enigk (K.) & Grittner (I.). **Zur Zucht und Biologie der Zecken.** [The Breeding and Biology of Ticks.]—*Z. Parasitenk.* **16** pt. 1 pp. 56–83, 3 figs., 2 pp. refs. Berlin, 1953.

Simple techniques for laboratory rearing of Argasids and Ixodids and methods for confining them on suitable hosts are described. Information on the bionomics of the ticks, essential for successful breeding, is given from the literature and from observations on 30 species reared by the authors, and includes the optimum periods in which to offer blood-meals, the duration of engorgement, factors affecting oviposition, the effects of tick bites on birds and mammals, and temperature and humidity requirements of all stages when not on the host. A brief account is given of experiments in which concentrated vapour from phenol, formalin, BHC, ethyl dixanthogen, ammonium sulphide, sulphurous acid or chloroform was toxic to eggs of *Ornithodoros moubata* (Murr.). Diseases and abnormalities that occur among ticks reared in the laboratory are described.

Wilkinson (P. R.). **Observations on the sensory Physiology and Behaviour of Larvae of the Cattle Tick, *Boophilus microplus* (Can.) (Ixodidae).** —*Aust. J. Zool.* **1** no. 3 pp. 345–356, 1 pl., 19 refs. Melbourne, 1953.

The following is virtually the author's summary of field and laboratory observations made in Queensland to facilitate the development of a field sampling method for larvae of *Boophilus annulatus microplus* (Can.). The main sense organs that have been recognised in the larvae are the eyes, Haller's organs, and the palpal organs; the four pairs of sensilla sagittiformia may also have a sensory function. Larvae were allowed to ascend supports simulating grass stalks and were tested for response to vibration, air currents, interrupted illumination, warm and moist objects, and odours from skin secretions of man and cattle. The strongest questing response was to the odours. Larvae that had been exposed to low humidities collected around and imbibed from drops of water.

The main stimulus governing ascent of the grass blades appeared to be positive phototaxis to moderate light intensities. Larvae sheltered from direct sunlight. Larvae in the field were found to be more exposed in the early morning, often being at the tops of grass stalks. Measurements of light, air temperature, and humidity indicated that light intensity might govern this movement. This suggests that larval sampling in the pasture should take place in the first half of the morning. In a single series of observations, larvae that had hatched at the base of straws were observed to ascend them in the late afternoon. In a few experiments, isolated larvae ascended artificial supports above the reach of a bovine host, but groups were always found at heights within reach.

Addison (C. C.) & Furmidge (C. G. L.). **Physicochemical Studies on the Application of Insecticides to Sheep Fleece. V. The Influence of Carbon-chain Length and Halide Ion of cationic Wetting Agents on their Reaction with natural Fleece.**—*J. Sci. Fd Agric.* **5** no. 5 pp. 212–220, 9 graphs, 6 refs. London, 1954.

The following is virtually the authors' summary of this paper, which belongs to a series [*R.A.E.*, B **41** 129; **42** 129]. The influence of variation in chain-length on the reactions between fleece and cationic wetting agents has been studied, with particular reference to octadecyl-, cetyl-, tetradecyl- and dodecyl-pyridinium chlorides. Reactions with cetyltrimethylammonium

chloride closely resemble those with cetylpyridinium chloride. The inactivation of the wetting agents, and changes in weight of the fleece samples, have been determined over ranges of concentration, and the two properties correspond closely in all instances. With octadecyl and cetyl compounds considerable inactivation occurs, but with the tetradecyl and dodecyl compounds the interfacial activity of the wetting agent is enhanced; this is attributed to the increase in the solubility of the long-chain cation–suint anion complex with decrease in cation chain-length. At C_{14} and below, the flocculation of suspended matter, which is typical of the longer chains, does not occur. All the curves may be interpreted on the basis of the three mechanisms already discussed [**41** 129]. The effect of addition of sodium chloride on reactions with cetylpyridinium chloride is considered. Dodecyl- and tetradecyl-pyridinium compounds have been used to compare the properties of the various halides. The change in properties produced by the change from chloride to bromide or bromide to iodide is approximately equivalent to that produced by an increase of two carbon atoms in the cation chain-length.

Mimioğlu (M. M.). **Türkiye'de tavuklarda Mallophaga'lar (tavuk bitleri) ve en uygun mücadele metotları üzerinde araştırmalar.** [Studies on the Mallophaga of Fowls (Chicken Lice) and the best Methods of Control in Turkey.]—*Yayın Ankara Üniv. vet. Fak.* [no.] 32 (Çalışm. [no.] 16), [3 +] 60 pp., 32 figs., 60 refs. Ankara, 1952. (With Summaries in English and French.)

Mallophaga are the commonest pests of fowls in Turkey, and a survey by the author in various parts of the country showed that 95 per cent. of the birds examined were infested by them. The eight species found were *Goniodes dissimilis* Denny, *G.* (*Goniocotes*) *gigas* (Tasch.), *Goniocotes gallinae* (Deg.) (*hologaster* (Nitzsch)), *Lipeurus caponis* (L.), *Cuclotogaster* (*Gallipeurus*) *heterographus* (Nitzsch), *Menacanthus* (*Eomenacanthus*) *stramineus* (Nitzsch), *M. cornutus* (Schömmer) and *Menopon gallinae* (L.), of which the last four were by far the most important. All are described, and a key to them is included. In tests on control, very good results were given by applying 5 per cent. DDT in vaseline to the head and neck, round the vent and under the wings.

King (W. V.). **Chemicals evaluated as Insecticides and Repellents at Orlando, Fla.**—*Agric. Handb. U.S. Dep. Agric.* no. 69, [2 +] 397 pp. Washington, D.C., 1954. Price $2.25.

This report is the summary of the results of tests at the Orlando laboratory of the U.S. Bureau of Entomology and Plant Quarantine of over 11,000 compounds received there prior to July 1952. The compounds are arranged in tables with figures indicating the effectiveness (in one of five categories) attributed to each in respect of the tests carried out with it. Nearly all the compounds were tested as mosquito larvicides and for toxicity, speed of action and ovicidal effect against *Pediculus humanus humanus* L., and large numbers of them as toxicants in space sprays and deposits against mosquitos and *Musca domestica* L., in dusts and on cloth against cockroaches and fleas, and on cloth against ticks and larvae of *Trombicula* spp., as repellents on skin and cloth against mosquitos and on cloth against fleas and ticks, and as synergists with pyrethrum extract against *P. h. humanus*. The species of mosquitos, fleas and cockroaches used in the tests are given; the tick was *Amblyomma americanum* (L.).

The ways in which the various tests were carried out are described in an introductory section.

Smith (C. N.), Cole (M. M.), Gilbert (I. H.) & Gouck (H. K.). **Field Tests with Tick Repellents—1949, 1950, and 1952.**—*J. econ. Ent.* **47** no. 1 pp. 13–19, 4 refs. Menasha, Wis., 1954.

Field tests of clothing treated with selected tick repellents were carried out during the summers of 1949, 1950 and 1952 in South Carolina and Georgia in areas heavily infested with nymphs and adults of *Amblyomma americanum* (L.). The best repellents in the early tests were later combined with repellents outstanding against mosquitos, fleas and Trombiculid larvae to provide an all-purpose mixture. Individual compounds were applied at 2 gm. per sq. ft. cloth and mixtures at 1·5–3·6 gm. Of the 44 compounds tested in acetone solutions and 21 in emulsions, the outstanding ones were N-butylacetanilide and N-propylacetanilide, which gave an average repellency of 97–98 per cent. for two or three weeks in both forms, and α-butoxy-N-cyclohexylacetamide, dicyclopentyl succinate, N-isopropylacetanilide and methyl propyl ester of bicyclo[2.2.1]-5-heptene-2,3-dicarboxylic acid, which were equally effective in emulsions and only slightly less so in solutions. Compounds with average repellencies of about 90 per cent. in emulsion form included undecylenic (hendecenoic) acid, Indalone, N-butyl-4-cyclohexene-1,2-dicarboximide, dimethyl carbate and hexyl mandelate. Of the four repellents applied to the clothing in aerosols, Indalone was ineffective but dimethyl carbate, ethyl β-phenylhydracrylate and 2-butyl-2-ethyl-1,3-propanediol had repellency percentages of 84, 87 and 79 as compared with 90, 65 and 79 when they were applied at a higher rate in emulsion. The effectiveness of Indalone, N-butylacetanilide and hexyl mandelate remained about the same whether they were applied as emulsions, as solutions in acetone, petrol or xylene or as undiluted sprays.

The most effective all-purpose mixtures were those containing N-butylacetanilide as the tick repellent. One of the outstanding mixtures, designated M-1960, contained 30 per cent. each of N-butylacetanilide, 2-butyl-2-ethyl-1,3-propanediol and benzyl benzoate and 10 per cent. Tween 80 as emulsifier [*cf. R.A.E.*, B **40** 62; **41** 203; **42** 39]. Toxicological studies indicated that it was acceptable for treating the clothing of military personnel, but its suitability for unsupervised civilian use has not been determined. It was found to be effective against Trombiculids, three species of mosquitos, two species of fleas and two additional species of ticks. In 1952, 13 mixtures, mostly modifications of M-1960, were compared with it against *A. americanum*. There was little difference between the most effective ones for the first three weeks, but five mixtures (all containing N-butylacetanilide) continued to show repellencies of 97–99 per cent. during the fifth and sixth weeks, when that of M-1960 fell to 93 per cent., and two of them, M-2059 and M-2040, were 97 and 96 per cent. effective during the eighth week, after an intervening period of wear. M-2059 had the same ingredients as M-1960 with the addition of a small amount of γ BHC (lindane), and M-2040 contained equal parts of N-butylacetanilide, N-butyl-4-cyclohexene-1,2-dicarboximide and undecylenic acid.

Miller (A. C.), Mallis (A.) & Easterlin (W. C.). **A testing Procedure for evaluating liquid Sprays against Cockroaches.**—*J. econ. Ent.* **47** no. 1 pp. 23–26, 1 fig., 10 refs. Menasha, Wis., 1954.

A procedure that the authors have used for several years to evaluate sprays against cockroaches is described. It is designated the " racetrack "

procedure because the cockroaches are confined on absorbent paper by a steel hoop 32 ins. in diameter and three ins. high, lightly greased on the inner wall, and usually run round it. The spray is applied from a distance of about 20 ins. with a Peet-Grady atomiser [*R.A.E.*, B **37** 6] modified to spray downwards, and the gun is rotated so that the whole area is sprayed. Dosages of 6 or 12 ml. are applied to simulate applications made in houses against *Blattella germanica* (L.) and occasionally 18 or 24 ml. to simulate exceptionally heavy dosages. The cockroaches remain in the enclosures for 10 minutes, and knockdown counts are made after 5, 10 and 30 minutes. Counts of dead and moribund cockroaches are made after 24, 48 and if necessary 72 and 144 hours. The standard figure for comparison is the total of the percentage dead and moribund at 48 hours. The figures obtained in each of the seven counts are given to show the effects of 6, 12, 18 and 24 ml. base oil on large nymphs of *B. germanica*, *Periplaneta americana* (L.) and *Blatta orientalis* L. and of 12 ml. base oil and 12 ml. OTI (about 0·1 per cent. pyrethrins) on nymphs of *P. americana* and *B. orientalis* and adult males of *Blattella germanica*.

Fales (J. H.), Bodenstein (O. F.) & Nelson (R. H.). **The synergistic Action of Sulfoxide in Insecticide Sprays and Aerosols.**—*J. econ. Ent.* **47** no. 1 pp. 27–29, 7 refs. Menasha, Wis., 1954.

An account is given of studies of the effectiveness of sulphoxide (n-octyl sulphoxide of isosafrole) as a synergist for pyrethrum and allethrin in sprays and aerosols. With sprays containing 0·2 mg. insecticide and 2 mg. synergist per ml. oil, tested against *Musca domestica* L., the ten-minute knockdown percentages and (in brackets) percentages dead in one day were 98 (85) for pyrethrins with sulphoxide, 97 (78) for pyrethrins with piperonyl butoxide, 56 (25) for allethrin with sulphoxide and 54 (34) for allethrin with piperonyl butoxide. Knockdown with sulphoxide was more rapid than with piperonyl butoxide. Space sprays containing allethrin plus DDT and either synergist gave similar knockdown and kill of *M. domestica*. When the two synergists were compared in pyrethrum sprays at a toxicant-synergist ratio of 1:6 against *Culex pipiens pipiens* L. and 1:4 against *Anopheles quadrimaculatus* Say, they gave similar mortality of the latter but the piperonyl-butoxide formulation gave a somewhat better kill of *C. p. pipiens*. All formulations gave high knockdown of both species.

In tests of high-pressure liquefied-gas aerosol formulations containing 0·4 per cent. pyrethrins or allethrin and 2 per cent. sulphoxide or piperonyl butoxide, knockdown and kill of *M. domestica* were about equal with the two pyrethrum aerosols, and higher than with the allethrin aerosols, in which sulphoxide was slightly less effective than piperonyl butoxide. Of low-pressure aerosols containing pyrethrins and synergist in the ratio of 2:5 together with DDT, the one containing sulphoxide gave rather better 15-minute knockdown and kill of *M. domestica* than the one containing piperonyl butoxide. When the formula of a well-known aerosol of pyrethrum and DDT used for treating aircraft was modified to include a synergist, knockdown and kill of *M. domestica* were better with sulphoxide than with piperonyl butoxide. Incorporation of 2 per cent. sulphoxide in another aircraft aerosol formulation resulted in a marked increase in both knockdown and kill of *M. domestica*. The first of these formulations gave 34 per cent. kill of large nymphs of *Periplaneta americana* (L.) and 54 per cent. kill of females within five days without sulphoxide and 60 and 78 per cent. with it.

Eddy (G. W.), McGregor (W. S.), Hopkins (D. E.), Dreiss (J. M.) & Radeleff (R. D.). **Effects on some Insects of the Blood and Manure of Cattle fed certain Chlorinated Hydrocarbon Insecticides.**—*J. econ. Ent.* **47** no. 1 pp. 35–38, 7 refs. Menasha, Wis., 1954.

The effects on certain Diptera of feeding on the dung of cattle that had received chlorinated-hydrocarbon insecticides in their rations or on the blood of those that had received lindane [γ BHC] were studied in Texas in 1950 and 1951. The cattle were fed on diets containing lindane at 10 and 100 parts per million for 84 days, dieldrin, aldrin or chlordane at 25 p.p.m. for 56 days, or toxaphene or technical BHC (12 per cent. γ isomer) at 100 p.p.m. for 112 days. Lindane at 100 p.p.m. was lethal to adults of *Siphona irritans* (L.) that fed on the cattle during the period of administration and for at least 21 days thereafter. There was some evidence of toxicity to adults of *Stomoxys calcitrans* (L.) and *Aëdes aegypti* (L.) that fed on one of these animals, but no evidence that its blood (mixed with ground beef) was toxic to larvae of *Callitroga hominivorax* (Coq.). Dung from one of the animals retarded growth of *Siphona* larvae fed during or six days after the end of treatment, and only a few adults emerged. It also retarded the development of larvae of *Musca domestica* L., but failed to prevent adult emergence. The lower dosage of lindane had no apparent effect on adults of *Siphona* on the cattle or larvae in the dung.

The dung of cattle that received dieldrin or aldrin was toxic to larvae of *Siphona*, *Stomoxys* and *Musca* during treatment and for at least 47 days thereafter, but there was no evidence that the dung was made toxic to larvae of either *Siphona* or *Musca* by chlordane, to larvae of *Musca* by technical BHC or toxaphene, or to *Musca* adults by technical BHC.

Larvae of *Hypoderma lineatum* (Vill.) were found normally encysted in the backs of animals that had been receiving the higher concentration of lindane for 84 days or dieldrin, aldrin or chlordane for 55 days; they showed no evidence of being affected adversely.

Hoffman (R. A.), Hopkins (T. L.) & Lindquist (A. W.). **Tests with Pyrethrum Synergists combined with some organic Phosphorus Compounds against DDT-resistant Flies.**—*J. econ. Ent.* **47** no. 1 pp. 72–76, 7 refs. Menasha, Wis., 1954.

Laboratory experiments were made to evaluate the effectiveness of deposits of seven organic phosphorus compounds in combination with 19 synergists against house-flies (*Musca domestica* L.) of a DDT-resistant strain. The phosphorus compounds were malathion, EPN [ethyl p-nitrophenyl thionobenzenephosphonate], methyl-parathion, Bayer compound 21/199 (3-chloro-4-methylumbelliferone O,O-diethyl thiophosphate), Bayer compound 21/200 (3-chloro-4-methylumbelliferone O,O-dimethyl thiophosphate), Potasan (4-methylumbelliferone O,O-diethyl thiophosphate) and Diazinon (O,O-diethyl O-(2-isopropyl-4-methyl-pyrimidyl (6)) thiophosphate). They were used at rates that caused low 24-hour mortality of flies exposed for ten minutes in treated jars when no synergist was added.

In tests of initial activity, most of the synergists increased the effectiveness of many toxicants, and some of them caused a very marked increase with most of them. These included piperonyl butoxide, sulphoxide [n-octyl sulphoxide of isosafrole], N-isobutylundecylenamide, the α-propyl piperonyl ester of chrysanthemic acid (chrysanthemum monocarboxylic acid) and 5-butyl-5-ethyl-2-(3,4-methylenedioxyphenyl)-m-dioxan. Piperonyl cyclonene and n-propyl isome were the least effective. Some of the toxicants were activated more than others. The two Bayer compounds and Potasan were

among the most effective with the synergists tested. In general, synergistic effect with malathion was less than with the other toxicants.

Five of the toxicants and eight of the synergists were used in tests of the duration of effectiveness. The toxicants alone with the low dosage and short exposure period used showed little or no initial toxicity and no toxicity by the fifth day. Some of the combinations were highly effective up to 39 days. N-isobutylundecylenamide was the best of the synergists tested when combined with malathion and EPN. Piperonyl butoxide was the most effective with the Bayer compounds and Diazinon, and 5-butyl-5-ethyl-2-(3,4-methylenedioxyphenyl)-m-dioxan and sulphoxide were also highly effective in combination with them.

Four toxicants were tested alone and with some of the best synergists in ratios ranging from 1:0·5 to 1:10 to evaluate the effectiveness of the different proportions. The results were somewhat erratic, but showed that the initial effectiveness of each toxicant was increased even by the smallest amount of synergist used and the initial activity of the combination was generally higher as the amount of synergist was increased. In general, the duration of effectiveness of a toxicant was also prolonged with increasing amounts of synergist although the smaller amounts of synergist in some combinations prolonged the action to a marked degree.

Therrien (A. A.), Hunter III (G. W.), Moon (A. P.) & Adams (A. L.). **Tests of potential Acaricides against the Lone Star Tick.**—*J. econ. Ent.* **47** no. 1 pp. 76–78, 6 refs. Menasha, Wis., 1954.

In plot tests at Camp Bullis, Texas, against *Amblyomma americanum* (L.) [*cf. R.A.E.*, B **39** 60] in the summer of 1952, dieldrin and aldrin at 0·25–1 lb. per acre, lindane (γ BHC) at 0·05–0·25 lb. and DDT and chlordane at 1–4 lb. were applied at concentrations in pyrophyllite that gave a total of 40 lb. dust per acre. Tick populations were estimated by an observer who stood or knelt on a square of white flannel, counted the ticks on it and on a towel spread at each of the four sides successively, and then returned them to the plot. The numbers before dusting and the reductions at counts at seven intervals after it are given in a table. Dieldrin at 1 and (in brackets) 0·25 lb. per acre gave 97·9 (78·5) per cent. reduction in ticks after 24 hours, 99·6 (97·5) per cent. after two weeks and 92·7 (94·8) per cent. after eight weeks, and was the most effective of the chemicals tested. DDT at 4 lb. was very nearly as effective as dieldrin at 0·25 lb. and was similar in that it gave satisfactory control over a period of eight weeks but did not effect a satisfactory reduction until 48 hours after application. Chlordane at 4 lb. per acre was effective within 24 hours but did not maintain a high rate of control for eight weeks. Results with aldrin and lindane were erratic.

Lindquist (A. W.) & Hoffman (R. A.). **Effectiveness of Cattle-rubbing Devices and Hand Dusting for Horn Fly Control.**—*J. econ. Ent.* **47** no. 1 pp. 79–81, 1 fig., 3 refs. Menasha, Wis., 1954.

Experiments with cable-type back rubbers [*R.A.E.*, B **40** 131] for treating cattle with insecticides against *Siphona irritans* (L.) were carried out in 1952 on 26 ranches, differing in climate and general topography, in various parts of Oregon, and good control was obtained for 30–70 days following a single application to the rubbers of 5 per cent. DDT or chlordane in oil. Pyrethrum with piperonyl butoxide gave poor to fair control. Numerous observations were made on the effect of the insecticides and rubbing devices on Tabanids, mosquitos and stable flies [*Stomoxys calcitrans* (L.)], but in no case was control obtained.

In 1950 and 1951, the hand application of a wettable powder containing 50 per cent. methoxy-DDT (methoxychlor) to the backs and sides of dairy cattle was tested in Oregon as a simpler alternative to spraying for the control of *Siphona irritans*, as many owners were unwilling to prepare sprays for small herds. A small handful of the powder sprinkled on each animal and lightly rubbed in gave effective protection for three weeks.

Sampson (W. W.). **The Control of Insect Flight in Food Processing Plants by residual Insecticides.**—*J. econ. Ent.* **47** no. 1 pp. 87–93, 28 refs. Menasha, Wis., 1954.

House-flies (*Musca domestica* L.) of a normally susceptible strain were exposed to deposits of 12 different insecticides, made from one hour to 12 months earlier, in laboratory and field tests carried out in California to investigate the effects of the insecticides in preventing or reducing the flight of Diptera in buildings in which food is processed and handled. All the insecticides were applied in refined kerosene, and DDT in lacquer and paint bases also. In the laboratory, two sets of exposure times were used. The shorter (0·5, 1 and 2 minutes) represented the time that flies are likely to rest undisturbed in certain active processing plants and the second (10, 20 and 30 minutes) represented the range of ordinary resting times at moderate temperature. It was determined by detailed observation of marked unexposed laboratory flies that they might spend 10 per cent. of their lives in flight. The distances flown by exposed laboratory flies were estimated from this. In the field, marked flies that had been exposed for one minute or 20 minutes were released in a cannery in April 1951 and 1952 and in a restaurant in March 1952. Positions at which dead flies were found indicated actual distances travelled from points of liberation, and the periods for which trapped flies survived indicated additional possible flight distances. Laboratory and both lots of field results were similar. Those for the cannery with 20-minute exposure are given in detail. BHC at 0·3 per cent. and DDT and methoxy-DDT (methoxychlor) at 5 per cent. in kerosene prevented flight completely for five months with this exposure. DDT at 2·5 per cent. in a paint base applied as a light coat was exceptionally good, preventing flight completely for nine months with the 20-minute exposure and reducing it to 0–38 ft. for the same period with one-minute exposure, but data in the literature indicate that this effectiveness might be unusual. Of the other insecticides tested, DDD, dieldrin, aldrin, chlordane, toxaphene and methyl-DDT prevented flight for four–two months with 20 minutes' exposure, while allethrin and pyrethrum alone and with piperonyl butoxide were much less effective.

Control of flight with exposure for one minute was erratic. It appears from this that the action of deposit insecticides is in general too slow to allow of the complete suppression of flight in food-processing establishments, which is necessary to prevent contamination of food. Factors influencing the insecticidal control of flight of insects in a building are discussed.

Varzandeh (M.), Bruce (W. N.) & Decker (G. C.). **Resistance to Insecticides as a Factor influencing the Biotic Potential of the House Fly.**—*J. econ. Ent.* **47** no. 1 pp. 129–134, 1 fig., 9 refs. Menasha, Wis., 1954.

Details are given of laboratory studies on the influence, if any, of the acquisition of resistance to insecticides on the factors combining to determine the biotic potential of *Musca domestica* L. Seven strains of flies, three

normally susceptible to insecticides and four highly resistant to one or more were compared in the study. The factors considered were number of eggs laid per female, weight of pupae and adults of both sexes, length of adult life in both sexes and percentage hatch of eggs and survival of larvae and pupae.

The following is based on the authors' summary of the results. Strain S-1, which was developed from a laboratory strain and showed no resistance to insecticides, had the lowest egg production and pupal weight, and the shortest length of female life and larval survival and was second to lowest in weight of adults of both sexes and pupal survival. Strain S-2, selected from a field collection and showing no resistance to insecticides, was highest or next to highest in all respects except weight of pupae and survival of larvae. Strain S-3, selected from a non-resistant laboratory strain, ranked at the top or next to the top of the list in all characteristics studied. Strain R-1, which was highly resistant to pyrethrins and moderately resistant to DDT and γ BHC as lindane, closely resembled the susceptible S-1 strain in its biotic potential. It ranked at or next to the bottom of the list for all the factors studied. Strains R-2, R-3 and R-4, which were, respectively, highly resistant to lindane and moderately resistant to DDT, highly resistant to DDT and Dilan [a 1 : 2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] and very resistant to DDT, maintained intermediate positions, usually ranking from third to fifth. The data obtained indicated that the factors associated with vigour are inherited independently of those associated with resistance.

Lea jr. (A. O.) & Dalmat (H. T.). **Screening Studies of Chemicals for larval Control of Blackflies in Guatemala.**—*J. econ. Ent.* **47** no. 1 pp. 135–141, 2 figs., 6 refs. Menasha, Wis., 1954.

The following is based on the authors' summary. A laboratory method for screening chemicals against Simuliid larvae is described. Larvae of *Simulium downsi* Vargas, Martínez & Díaz collected in the field in Guatemala were confined in batches of 25 in 3-inch lengths of one-inch diameter glass tubing, covered at either end with 80-mesh cheesecloth and were exposed for 30 minutes by immersing one end of the tube in the test fluid, which is stated to have been a water dilution (10 or 1 part per million) of a 1 per cent. stock solution of the test material. After treatment, the tubes containing the larvae were rinsed through with running water, a piece of leaf introduced, the contaminated cover changed and the tube inclined so that a thin film of water could be passed continuously through it and over the leaf with the attached larvae for a period of 36 hours, at which time mortality was recorded. Some 800 materials were tested by this technique, along with various well-known insecticides. EPN [ethyl p-nitrophenyl thionobenzenephosphonate], methyl-parathion, parathion, Metacide [a mixture of parathion and methyl-parathion] and sulfotepp [tetraethyl dithiopyrophosphate] were the most toxic materials, and TEPP [tetraethyl pyrophosphate], dieldrin, aldrin, heptachlor, DDT and chlordane were also effective. The effect of the test materials varied with season. In particular, DDT was generally more effective during the dry season than during the rains. This is probably because, during the rains, weak larvae are killed by mechanical action and only strong ones were available for testing. In field tests, results of which will be published later, streams in which the prinicipal man-biting Simuliids breed in the Municipality of Yepocapa were completely cleared of larvae by much lower concentrations of DDT, EPN, dieldrin, aldrin, heptachlor and chlordane and a shorter period of application than those used in the laboratory tests.

Ryckman (R. E.). **A Method of collecting large Quantities of Feces from Triatominae infected with** *Trypanosoma cruzi*.—*J. econ. Ent.* **47** no. 1 pp. 170–171, 1 fig., 1 ref. Menasha, Wis., 1954.

To obtain large quantities of faeces for inoculation experiments from Triatomines infected with *Trypanosoma cruzi*, large jars were made from plastic tubing, 10 cm. long and 9 cm. in diameter, closed at the bottom with a glass cap held by a screw cap band and at the top with nylon held on with adhesive tape. The bugs are released on to a piece of folded blotting paper held in place by adhesive tape so that the upper edge is at the top of the jar and the lower edge is some distance from the bottom. If not too crowded, they remain on the paper. To infect them, an infected animal is strapped over the top of the jar. Infected faeces can be collected 20–30 days later. When they are needed, the infected bugs are fed head upwards on a rabbit [*cf. R.A.E.*, B **41** 84]. During and immediately after feeding, the faeces drop uninterrupted to the bottom of the jar and can be collected with a pipette. In the case of *Triatoma infestans* (Klug) or other large species that defaecate rapidly after feeding, it is convenient to remove the lower cap and set the jar over a petri dish to collect several cubic centimetres of infected faeces. About 30 bugs formed a suitable colony of these large species, but 50 or more were needed of a small species such as *T. protracta* (Uhl.). Keeping a colony of infected bugs is the most practical method of maintaining a strain of *Trypanosoma cruzi*, because the bugs remain infected for life (often a year or more). If the blotting paper is extended for the full length of the jar and the bottom is covered with absorbent paper, the jars can be used as rearing units.

Love (G. J.). **Variations in Hatching of Ova in successive Lots obtained from colonized** *Anopheles quadrimaculatus* **Say.**—*J. econ. Ent.* **47** no. 1 pp. 178–179, 1 ref. Menasha, Wis., 1954.

Data are given on the number of eggs laid by 17 females of *Anopheles quadrimaculatus* Say isolated four days after emergence and the percentage hatch among the eggs. The females were given the opportunity to mate and engorge on a rabbit before isolation and daily opportunity to feed on human blood afterwards. Ten oviposited regularly 3–5 days after each blood-meal and produced 4–10 batches of eggs all of which showed a high rate of hatching. The other seven oviposited similarly, but the rate of hatching decreased in successive batches. In an experiment to determine whether repeated insemination would increase the proportion of eggs that hatched, 12,025 eggs of which 87 per cent. hatched were laid in 28 days by 25 females that had the opportunity to mate only for the first four days after emergence and 17,961 eggs of which 68 per cent. hatched were laid in 42 days by 25 females that could mate repeatedly. This suggests that the production of non-viable ova and not depletion of the supply of viable sperm may have been responsible for the decrease in the hatching rate.

Richardson (H. H.). **Preliminary Tests with Carbon Monoxide against several Insects.**—*J. econ. Ent.* **47** no. 1 pp. 182–183, 10 refs. Menasha, Wis., 1954.

In tests in 1943 against adults of *Tribolium confusum* Duv., all stages of *Cimex lectularius* L., eggs of *Pediculus humanus humanus* L., and nymphs and adults of *Periplaneta americana* (L.) and *Blattella germanica* (L.),

fumigation with carbon monoxide at a concentration of 18 lb. per 1,000 cu. ft. for 5 or 24 hours at 76–78°F. caused little mortality of any of the insects.

Beroza (M.) & Bottger (G. T.). **The insecticidal Value of *Tripterygium wilfordii*.**—*J. econ. Ent.* **47** no. 1 pp. 188–189, 11 refs. Menasha, Wis., 1954.

In the course of investigations noticed elsewhere [*cf. R.A.E.*, A **42** 398], it was observed that the root of *Tripterygium wilfordii*, tested at 50 mg. per ml. in oil spray, was not toxic to *Musca domestica* L. and showed no synergism with pyrethrins. Both the root and the non-crystalline fraction derived from it [*loc. cit.*] were ineffective as poisons in baits for *M. domestica*, but the latter gave 100 and 16 per cent. mortality of mosquito larvae in 48 hours at concentrations of 10 and 0·1 parts per million, respectively. Rats were not poisoned when fed on bait containing 20 per cent. ground whole root or 0·5 per cent. crystalline alkaloid or non-crystalline fraction.

Hoffman (R. A.). **Observations on Fly Control by Sanitation.**—*J. econ. Ent.* **47** no. 1 p. 194. Menasha, Wis., 1954.

On an old-fashioned dairy farm in California with unscreened windows, the population of house-flies [*Musca domestica* L.] was consistently kept low during 1953 by strict sanitation without the use of insecticides. The wooden floors of the barn and milking room were seldom washed but were swept daily with a stiff brush and all dung scattered outside in a thin layer to be dried by the sun. The corral was also regularly swept and the dung spread. As little water was used in cleaning, no sump or liquid-manure pit was needed. The calf pens were kept clean and dry. No enriched feeds or additives that attract flies were used. Milk and milk products were never left uncovered, and no excess feed was allowed to accumulate in the racks. Periodic observations throughout the summer never revealed the presence of more than 20 flies at one time in the dairy. On a neighbouring farm, which was sprayed several times during the season but where only the usual sanitary precautions were observed, fly counts of 20–50 per minute were obtained frequently with a baited grid.

Grandori (L.), Reali (G.) & Facetti (D.). **Effetti narcotici dell'etiluretano sulla mosca domestica adulta.** [Narcotic Effects of Ethyl Urethane on adult House-flies.]—*Boll. Zool. agr. Bachic.* **18** fasc. 1 pp. 3–10, 2 refs. Milan, 1952. (With Summaries in French and English.)

Grandori (L.) & Facetti (D.). **Ulteriore sperimentazione sugli effetti dell'etiluretano sulla mosca domestica adulta.** [Further Experiments on the Effects of Ethyl Urethane on adult House-flies.]—*T.c.* pp. 21–28, 1 fldg. table, 1 ref. (With Summaries in French and English.)

The finding that carbacholine is toxic to house-flies (*Musca domestica* L.) [*R.A.E.*, B **42** 130] led to investigations on the specific action on the flies of the several groups present in the molecule, and the results obtained with ethyl urethane are presented in these two papers.

In the first, the physical, pharmacological and biochemical properties of ethyl urethane are reviewed; it is a crystalline solid that sublimes rapidly at 16°C. [60·8°F.] and has a mild narcotic effect on man. In the tests, 5, 1 and 0·1 per cent. solutions of it were injected into the prothorax of the flies by means of a micropipette; exact calculation of the amount

administered was not possible, since some was expelled from the wound with the oozing haemolymph. The strongest solution caused immediate knockdown with no recovery. The second caused knockdown, followed by a recovery of normal movement and in some individuals of flight, and this was succeeded 1–18 hours later by gradual torpor, leading to death. The weakest solution caused no knockdown, but torpor ensued after 24 hours of normal behaviour.

When the flies were confined in covered petri dishes with deposits of 1–8 gm. of the urethane per sq.m. on the bottom, or in a bell-jar bearing deposits of 2 gm. per sq. m., all those exposed to 2 gm. or more per sq. m. were knocked down within two hours, narcosis and death ensuing. When the dishes were covered with gauze only, the onset of narcosis was delayed. In the final tests, the flies were confined in air-tight vessels and prevented from coming into contact with the urethane. Narcosis occurred within two hours when the urethane was allowed to sublime for 24 hours before the flies were introduced, but was delayed when urethane and flies were introduced simultaneously.

It is concluded that the effect of the compound is due, even when contact with it is permitted, to penetration of the respiratory system by the vapours arising from sublimation.

The experiments recorded in the second paper were carried out to investigate further the action of ethyl urethane on injection, and a microsyringe was used to introduce 0·0004 cc. solution containing urethane into various parts of the body. The solvents were Levy's physiological solution and distilled water. Injection of 1 per cent. urethane in Levy's solution into the head had no narcotic effect, and a 5 per cent. solution merely caused knockdown for about 15 minutes, after which normal activity was gradually resumed. Water solutions gave similar results. The same solutions injected into the thoracic ganglia and 1, 5 and 10 per cent. solutions in either solvent injected into the abdomen also failed to cause irreversible narcosis. There was some mortality in all tests due to the puncture, but it was no greater for the solutions than for the solvents alone.

It thus appears that the urethane has no irreversible narcotic effect when injected into the body, though an eventual toxic action is not excluded.

Kocher (C.), Roth (W.) & Treboux (J.). **Die Bekämpfung resistenter Stubenfliegen** (*Musca domestica* **L.**) **mit Diazinon.** [The Control of resistant Houseflies (*M. domestica*) with Diazinon.]—*Anz. Schädlingsk.* **26** pt. 5 pp. 65–71, 39 refs. Berlin, 1953.

Research in Switzerland on insecticides for use against strains of *Musca domestica* L. resistant to DDT and other halogenated hydrocarbons has resulted in the development of several new toxicants, including Pyrolan (1-phenyl-3-methyl-pyrazolyl(5) dimethylcarbamate) [*cf. R.A.E.*, B **41** 69] and Diazinon [O,O-diethyl O-(2-isopropyl-4-methyl-pyrimidyl(6)) thiophosphate]. The latter appeared particularly promising [**41** 198], and results are given of numerous laboratory and field tests in which it was applied in many forms and its toxicity to normal and resistant flies compared with that of commonly used insecticides. Flies 3–4 days old were taken for all the laboratory tests with adults. The resistant strain used in the laboratory had been exposed to DDT for several years and had acquired greater resistance to many insecticides than is likely to be found in any natural strain.

Solutions of Diazinon, DDT, lindane (almost pure γ BHC) and Pyrolan in acetone were evaporated in rotating flasks, leaving an even deposit of 5 mg. toxicant per sq. m. After 24 hours, normal and resistant flies of

both sexes were introduced, left for ten minutes, and then transferred to clean containers provided with food. They were inspected at fixed intervals for up to seven hours, and mortality was noted after 24 hours. Diazinon caused complete knockdown of normal and resistant flies in 20 and 60 minutes, respectively. Knockdown percentages for the two strains after seven hours were 15 and 6 for DDT, 100 and 57 for lindane and 27 and 17 for Pyrolan. Diazinon caused complete knockdown or mortality of both strains in 24 hours, and the other insecticides did not.

In tests of the duration of effectiveness, solutions of Diazinon in oil were applied to glass, pine blocks and pieces of wallpaper to give deposits of 0·2, 0·5 or 1 gm. toxicant per sq. m. The treated objects were stored at 18–28°C. [64·4–82·4°F.] and 40–60 per cent. relative humidity and used in contact tests after 1, 7, 14, 21 or 28 days. The results are given in tables; with exposure times of 60 and 120 minutes for the normal and resistant strains, respectively, all the deposits gave complete knockdown of both strains thoughout the month on wallpaper, and of the resistant strain for at least a fortnight and of the normal one for at least a week on glass and wood.

In tests of knockdown effect on exposure to a spray, solutions containing Diazinon or DDT at 1, 2·5 and 5 per cent. or pyrethrins at 0·1 per cent. were atomised in small chambers, at a rate equivalent to 0·1 fl. oz. solution per 4 cu. ft. The flies were introduced into the spray mist immediately and kept at 20°C. [68°F.]. DDT was ineffective at all concentrations against resistant flies and the pyrethrins gave only 26 per cent. knockdown in 25 minutes. All concentrations of Diazinon caused some knockdown in ten minutes and complete knockdown in 15–25 minutes. Complete knockdown of normal flies was given by the pyrethrins in ten minutes, by all concentrations of Diazinon in 15 minutes and by 2·5 and 5 per cent. DDT in 40 and 20 minutes, respectively.

Liquified-gas aerosol solutions containing 2·5 per cent. Diazinon or 0·3 per cent. pyrethrins were released at rates equivalent to 0·1 oz. per 500 cu. ft. in rooms containing normal or resistant flies. Diazinon gave complete knockdown of the two strains in 50 minutes and pyrethrins in 40 and 60 minutes, respectively.

Further tests were made with a spray powder suitable for use in animal quarters. A spray containing 0·25 per cent. Diazinon was prepared from it and applied to glass, pine blocks or whitewashed porous tiles at about 120 cc. per sq. m. The treated objects were kept at 18–20°C. and flies confined on them after 1, 7, 14 or 21 days. Resistant flies were exposed for 120 minutes and normal ones for 60. Knockdown of both strains was always complete in 30–60 minutes on glass or wood, but the deposit on tiles was scarcely effective after the first day.

In experiments against full-grown larvae, Diazinon and other insecticides were dissolved in acetone and mixed with the food medium, the numbers of adults emerging being counted after 15 days. Diazinon at 5 parts per million and Pyrolan at 200 p.p.m. were completely effective against both strains and were superior to the other insecticides, which, in order of effectiveness, were lindane, Dimetan (5,5-dimethyldihydroresorcinol dimethylcarbamate [*cf.* A **40** 360]), aldrin, chlordane, DDT and pyrethrins.

A 1 per cent. Diazinon dust on glass at 2·5 gm. toxicant per sq. m. caused complete knockdown of resistant and non-resistant adults confined on it for 30 and 20 minutes, respectively, and was more rapid in action than similar deposits of DDT, Pyrolan or lindane, especially against the resistant strain. In tests with smoke-producing papers containing 11 per cent. Diazinon or lindane, burned at rates of 0·5 and 1·5 oz. paper per 1,000 cu. ft. against non-resistant and resistant strains, respectively, lindane caused 93

and 67 per cent. knockdown, respectively, in an hour and Diazinon complete knockdown in 30 minutes. After 24 hours all the flies treated with Diazinon and all the non-resistant flies treated with lindane were either dead or on their backs, but 3 per cent. of the resistant flies exposed to lindane smoke remained normal.

Practical tests were carried out in 1951–52 in parts of the canton of Valais where house-flies had developed resistance to DDT by 1948–49 and to chlordane, BHC and dieldrin by 1951, so that a survey made in the autumn of 1952 revealed that no currently used insecticide gave effective control. In September 1951, animal quarters were treated by spraying the whole of the interior, except the floor and a strip of wall within 3 ft. of it, with a 0·125 per cent. Diazinon suspension at about 150 cc. per sq. m. Observations at fortnightly intervals showed that whereas infestation in the controls was heavy, the treated buildings were free from flies in the morning and those entering during the day were killed. The treatment was still effective six weeks after application. The tests were repeated in April 1952, when both 0·125 and 0·1 per cent. sprays were used, and animals retained in their quarters during the treatment suffered no ill effects. The buildings were freed from house-flies and other Diptera in 10–15 minutes, and 100, 90, 56 and 27 per cent. of them were still uninfested after 4, 6, 8 and 10 weeks, respectively. Similar treatment in another area gave similar results. The sprays were effective for longer on wood, concrete and stone than on tiles.

The walls and ceilings of houses were extensively sprayed with 2·5 per cent. Diazinon in oil at 10–12 cc. per sq. m. Here also resistant house-flies were well controlled for 3–4 weeks, after which cold weather reduced infestation, and the treatment still showed considerable effectiveness after six weeks, particularly in wooden buildings. It was observed that lindane and especially pyrethrins soon affected resistant flies, but some always recovered after a short time. There were no recoveries with Diazinon.

GREEN (A. A.). **The Control of Blowflies infesting Slaughter-houses. II. Large-scale Experiments.**—*Ann. appl. Biol.* **40** no. 4 pp. 705–716, 6 refs. London, 1953.

A large-scale trial of measures for the control of blowflies infesting slaughter-houses in Britain [*cf. R.A.E.*, B **39** 205–207] was carried out in 1948–50 in a heavily infested abattoir. The premises covered about eight acres and consisted of 18 slaughtering bays with their hanging rooms, and a number of chilling rooms and buildings connected with the by-product industries. A concrete yard at the rear contained the midden (a mixture of congealed blood, gut contents and other slaughter-house refuse) and had an acre of waste ground covered with grass and weeds immediately behind it. The lairages were about 200 yards away and covered a further 12 acres. The blowfly population comprised the six species already recorded [**39** 205] and was made up by breeding on the premises and immigration from outside.

Preliminary tests of insecticides to minimise infestation of the refuse were made because, although the flies could not develop in it on the premises if it was removed at frequent intervals, it would contribute to the general blowfly population after removal. When mixed with infested refuse, a dust of 4 per cent. crude BHC at 1 lb. per cwt. did not kill the larvae, and a mixture of o-dichlorobenzene, carbon tetrachloride and kerosene killed the few with which it came in contact but could not be distributed evenly enough to kill many and did not prevent oviposition. In tests of insecticides applied to the surface of small heaps of refuse weighing about 3 cwt. when first prepared, and with a surface area of about 5 sq. ft.,

single applications of dusts of 5 per cent. DDT or 4 per cent. crude BHC or sprays of oil containing 5 per cent. (w/v) DDT, 0·35 per cent. γ BHC, 0·1 per cent. pyrethrins, or 0·3 per cent. DDT with 0·03 per cent. pyrethrins, at rates of 4 oz. dust or 200 ml. spray per heap, did not prevent oviposition. When applied each day for four days, the two dusts at 50 gm., the oil sprays of BHC or pyrethrins with or without DDT at 50 ml., and a spray of DDT in emulsified solution at a rate giving 2·5 gm. DDT per heap all reduced the numbers of flies visiting the heaps and the larval populations, though control of the latter was less satisfactory in hot weather than in cool. Pyrethrum was the most effective in repelling the adults and DDT, especially in August, when species of *Lucilia* were predominant, in controlling the larvae. The DDT and BHC dusts and the emulsified solution all destroyed a considerable number of emerging flies. The combined effect on larvae and adults made the emulsified solution the most effective treatment, but the DDT dust was almost as good and was selected for the practical work because it was cheap and easy to apply.

The large-scale trial was initiated towards the end of August, when blowflies were more numerous than at any earlier time during the year and appeared to be increasing. For the rest of that summer and during the summers of 1949–50, blood and other by-products were collected, where possible, at intervals of two days, destructible waste was burned daily, and a rotation system of storage and collection, whereby refuse normally remained in the midden for no more than two days, was adopted. As a result, breeding on the premises was virtually prevented. The DDT dust applied daily over a period of six weeks in 1948 to the surface of all refuse, the midden yard and, after preliminary experiments had shown that there was no risk of driving the flies elsewhere, to a strip of vegetation ten ft. wide on the waste land behind the midden gave satisfactory results [*cf.* **39** 207]. After the heavy resident adult population had been eliminated, the density of the small residual population, presumably of immigrants, fluctuated with weather conditions and the amount of attractive material in the yard. The dusts were applied towards the end of the afternoon, when most of the refuse had been deposited in the yard and many of the flies were congregated there and were killed by direct action. In 1949 and 1950, the daily applications were continued and all vegetation within 50 yards of the midden received a heavier application every six weeks, but the treatment was carried out by unskilled labour and the degree of control obtained was in consequence reduced, though the blowfly populations were nevertheless maintained at a low level. Thus the average numbers of flies caught per sweep of a net over the most densely populated part of the vegetation were 218·2 and 2·8 before and during the experimental treatment in 1948 and 6·9 and 15·1 during the treatment in 1949 and 1950. There was no evidence of increased resistance to DDT among the blowflies. Although improved hygiene prevented breeding at the slaughter-house, chemical control continued to be necessary against flies that entered the premises daily from outside, and the possibility of dealing with these at their breeding places is therefore under investigation.

LEESON (H. S.). **The recorded Distribution of certain Tsetse Flies and of human Trypanosomiasis in Africa.**—*Trans. R. Soc. trop. Med. Hyg.* **47** no. 2 pp. 130–133, 4 maps, 10 refs. London, 1953.

Maps are given showing the recorded distributions of *Glossina morsitans* Westw., *G. palpalis* (R.-D.), *G. swynnertoni* Aust., *G. longipalpis* Wied., *G. pallidipes* Aust., *G. tachinoides* Westw., *Trypanosoma gambiense* and *T. rhodesiense*. Comments are made on whether gaps that appear in the

areas occupied by some of the flies are known to be real or may be due to lack of information, and on points in which the map of distribution of *G. palpalis* differs from one given by Vanderplank [*R.A.E.*, B **40** 144]. The maps for the two sleeping-sickness trypanosomes are based on records since 1920.

Satchell (G. H.) & Harrison (R. A.). **Experimental Observations on the Possibility of Transmission of Yaws by wound-feeding Diptera, in Western Samoa.**—*Trans. R. Soc. trop. Med. Hyg.* **47** no. 2 pp. 148–153, 5 refs. London, 1953.

To investigate the possibility that yaws is transmitted by wound-feeding Diptera in Samoa, over a thousand flies were collected from wounds on children attending a clinic on Manono. They were found to comprise 544 individuals of *Musca domestica vicina* Macq., 488 of *M. sorbens* Wied., 6 of *Atherigona excisa* (Thoms.) and one of *Sarcophaga peltata* Aldr. *M. sorbens*, which has transmitted yaws to man experimentally [*R.A.E.*, B **25** 44], and *M. d. vicina* were the dominant flies taken outside and inside the house, respectively, where they comprised 66·4 and 81 per cent. of the 244 and 278 flies collected. Over 80 per cent. of both species were females. All four species were also taken in a trap baited with a rotting chicken head. Flies on wounds were particularly abundant in bright sunny weather.

A number of examples of the two species of *Musca* and one example of *A. excisa* were allowed to feed on yaws lesions from which fluid was exuding and were then examined for spirochaetes in the crop or gut or on the proboscis. All those found had the characters of *Spirochaeta* (*Treponema*) *pertenuis*, but those in a few of the crops and most of the guts were non-motile. Motile spirochaetes were recovered from 32 of 44 crops of *M. sorbens* and 12 of 22 crops of *M. d. vicina* examined up to two hours after the flies had fed, and from one of 18 *sorbens* crops and none of five *vicina* crops examined during the next eight hours. They were found in the crop of *A. excisa* 20 minutes after it had fed. They were also recovered from the gut contents of a minority of the flies (all *M. sorbens*), from the proboscis of six (including all three species) out of 18, and from three of five vomit drops. Infection of the vomit drop would be expected, as it comes from the crop, and there was no evidence that the spirochaetes remained viable on the proboscis for any length of time. It was proved experimentally that *M. d. vicina* and *M. sorbens*, if interrupted while feeding on a yaws lesion, may subsequently feed on some other type of lesion, even though a yaws lesion is available. It has been shown that 13 per cent. of the population of Manono have infective yaws lesions, while the majority have lesions due to other causes, notably impetigo and scabies [*Sarcoptes scabiei* (Deg.)]. There is thus ample opportunity for flies, which are abundant, to transmit yaws.

Draper (C. C.). **Observations on the Infectiousness of Gametocytes in Hyperendemic Malaria.**—*Trans. R. Soc. trop. Med. Hyg.* **47** no. 2 pp. 160–165, 12 refs. London, 1953.

The following is largely based on the author's summary. The form that anti-malaria measures should take and their scope can be determined rationally by a mathematical study of the relationship between the various factors involved [*cf. R.A.E.*, B **42** 82]. One of the important variables is the degree of infectiveness of the gametocyte carriers to the mosquitos. An account is given of a small series of experiments in the hyperendemic zone of south-western Nigeria in which females of *Anopheles gambiae gambiae* Giles were allowed to feed on children carrying different densities

of gametocytes of *Plasmodium falciparum* and were then examined for oöcysts and sporozoites. In the community from which the subjects came, about 83 per cent. of all carriers of *falciparum* gametocytes showed less than 100 per cu. mm., and it is estimated from the results of the experiments that only about 5 per cent. of mosquitos feeding once on this group could become infective if they lived long enough, whereas about 50 per cent. of the mosquitos feeding on subjects with more than 100 gametocytes per cu. mm. could do so. Other workers have found a higher proportion infected in the first group [**35** 4]. The figures obtained are used in a hypothetical example to calculate the proportion of all females of *A. gambiae* feeding on the population at one time that could become infective.

Shemanchuk (J. A.), Spinks (J. W. T.) & Fredeen (F. J. H.). **A Method of tagging Prairie Mosquitoes (Diptera: Culicidae) with Radio-phosphorus.**—*Canad. Ent.* **85** no. 7 pp. 269–272, 1 graph, 7 refs. Ottawa, 1953.

Radioactive mosquitos have been obtained both by feeding the adults on radioactive food and by rearing the larvae in radioactive media [*R.A.E.*, B **39** 135]. Recent experience with Simuliids has shown that exposure of the larvae for a limited period was adequate to produce radioactive adults [**42** 92]. In a laboratory experiment made in 1951 with two species of *Aëdes* to determine the concentration of radioactive phosphorus that would enable the largest number of larvae to be treated per unit of medium with exposure for 24 hours and give a readily detectable degree of radioactivity in the adults, 0·1 microcurie and one larva per ml. solution proved satisfactory.

In a field experiment in Saskatchewan, designed to confirm this, fourth-instar larvae of four species of *Aëdes* were collected from flood pools and exposed in tubs under these conditions to the radioactive solution and then placed in an open-topped cage in a natural habitat until emergence. Radioactivity of the larvae tested ranged from 4,200 to 35,000 disintegrations per minute, with most in the range 7,500–12,000. It was estimated that 470,000 healthy larvae were exposed to the radiophosphorus and placed in the rearing cage for development and adult dispersal. About 418,500 adults were collected in light-traps and by sweeping about the release site, and three radioactive mosquitos and eight radioactive cyclorraphous flies were caught. The latter are not predacious and have no aquatic stages and it is assumed that they became radioactive through feeding on the radioactive solutions that were used for the mosquito larvae. The mosquitos had radio-activities of 1,200, 1,600 and 1,800 disintegrations per minute. The method was thus shown to be satisfactory. It also avoids the mortality caused by a longer period of rearing under artificial conditions and reduces possible risk of over-exposure to surface irradiation or the assimilation of a lethal dose of radiophosphorus. It is economical because the solution can be used several times if enough radioactive element is added to maintain its strength.

Charles (L. J.). **A Field Experiment in residual Control of the Adults of *Culex fatigans* in British Guiana.**—*Ann. trop. Med. Parasit.* **47** no. 2 pp. 113–125, 1 pl., 2 graphs, 8 refs. Liverpool, 1953.

In British Guiana, where control of *Anopheles darlingi* Root and *Aëdes aegypti* (L.) has been achieved by means of DDT deposit sprays [*cf. R.A.E.*, B **42** 160, etc.], *Culex pipiens fatigans* Wied., the vector of *Wuchereria bancrofti*, remains the only important house-frequenting mosquito. The conditions for its breeding in the inhabited coastlands, which are very favourable, are described. It is very abundant [**39** 109] and by 1950 and

1951 comprised 98 and 97·3 per cent., respectively, of all mosquitos taken in periodical morning catches in houses in the coastlands. An account is given of a field experiment carried out in a suburban area of Georgetown on its control with various deposit insecticides three years after the previous DDT applications had ceased. Sprays of DDT, BHC, chlordane and a mixture of DDT and chlordane were applied to give deposits of 150 mg. DDT, 12 mg. γ BHC, 90 mg. chlordane, and 150 mg. DDT with 60 mg. chlordane, respectively, per sq. ft. All were applied in kerosene solution and DDT and BHC in wettable-powder suspension also, and each of the six formulations was used to treat ten wooden houses together with their outhouses and latrines. Ten unsprayed houses served as controls. Weekly morning catches were made in the principal bedroom of each house three times before treatment and 16 times after it and were followed by monthly catches until a year had elapsed. Catches varied widely from week to week and were highest in the week before treatment. Estimates of the effectiveness of the treatments were based on the catches in the first ten weeks after spraying and the 28th and 32nd weeks, as these were the only weeks in which the catches in the controls were not significantly reduced by seasonal fluctuations. The mean catches for the first ten weeks were significantly lower in all the sprayed house-groups than in the controls and significantly lower for the two sprays containing chlordane than for those containing DDT only. The rise in catches during the 28th and 32nd weeks, after the intervening reduction, occurred in all the groups of houses treated, and the group treated with the heavier deposit of chlordane was the only one in which the catch in the 32nd week was significantly lower than the pre-spraying peak. It is concluded that complete control of *C. p. fatigans* with the insecticides tested is unlikely to be attained unless larvicidal measures are also used.

Kirk (R.) & Lewis (D. J.). **Taxonomy of the Ethiopian Sandflies (*Phlebotomus*). V. On *Phlebotomus africanus* Newstead, 1912.**—*Ann. trop. Med. Parasit.* **47** no. 2 pp. 126–131, 1 fig., 8 refs. Liverpool, 1953.

In this part of a series [*cf. R.A.E.*, B **40** 125, etc.], the authors set out the reasons for their conclusions [**41** 17] that the true *Phlebotomus africanus* Newst. and *P. squamipleuris* Newst. are identical, that the latter name should be used for this species, and that the *P. africanus* of Adler & Theodor [**14** 96] and subsequent authors with its varieties are conspecific with *P. freetownensis* Sinton. *P. freetownensis* thus becomes the type of a group that is well represented in, but not restricted to, the Ethiopian Region and includes vars. *magnus* Sinton (*P. africanus* of Adler, Theodor & Parrot [**18** 4]), *asiaticus* Thdr., *sudanicus* Thdr., *ater* Parr., *eremitis* Parr. & de Jolinière, *longior* Parr., *niger* Parr. & Schwetz, *cherifianus* Ristorcelli, and *meridianus* De Meillon & Lavoipierre.

Hutchinson (M. P.). **The Epidemiology of Human Trypanosomiasis in British West Africa. I. The Gambia, with special Reference to Upper River Division.**—*Ann. trop. Med. Parasit.* **47** no. 2 pp. 156–168, 3 maps, 5 refs. Liverpool, 1953. **II. The Gambia.**—*T. c.* pp. 169–182, 2 pls., 5 refs.

The following is substantially the author's summary. In these two parts of a series, an account is given of the epidemiology of sleeping sickness in the Gambia, where it is caused exclusively by *Trypanosoma gambiense*, based partly on a survey carried out in 1951–52 and involving an examination of some 55,000 people, and partly on the records. It was found that

the disease has been present in the Gambia for at least 100 years. Its distribution has remained remarkably constant during the past 50 years, but its incidence increased during the decade beginning in 1925, possibly in connection with large-scale immigration. It has now again reached a natural balance. It is of a relatively mild chronic type. Its incidence in the Upper River Division is high only in villages in the immediate neighbourhood of a few fresh-water creeks, but it is widely distributed in the maritime region.

A detailed study of the epidemiological factors involved has revealed that the distribution of the disease coincides exactly with that of *Glossina palpalis* (R.-D.) and that the level of endemicity is directly and closely correlated with the type and duration of the contact between man and *G. palpalis*. Where there is no contact, the disease does not occur; where contact is impersonal (*i.e.*, the same fly community is not living on the same group of human hosts) or where it is interrupted or only occasional, a low incidence is to be found; where contact is intimate, personal and sustained, there is a high level of endemicity. The type and duration of man's contact with *G. palpalis* is influenced in some localities by tribal custom and occupation. The disease does not occur in the absence of *G. palpalis* even though *G. morsitans* Westw. may be prevalent. It is concluded that *G. palpalis* is the sole vector.

Except in the maritime region, where prevailing high humidity enables *G. palpalis* to disperse over long distances, climatic conditions severely restrict the species, both in respect of its perennial haunts and of its ability to disperse from them. Where dispersal is restricted, the disease is correspondingly localised. In the Gambia, man is largely segregated from the haunts of *G. palpalis*, because the villages are situated well back from the main river to avoid floods, supplies of well water are available almost everywhere, there is practically no fishing industry and canoe travel is rare. There is thus little likelihood that the disease will spread or increase greatly in incidence, unless there are radical socio-economic changes.

The clear epidemiological picture obtained makes it possible to indicate the potentially dangerous areas where constant vigilance is needed, to advise on the type of control measures to be undertaken and to decide on the priority that should be accorded to such measures. In Upper River Division, partial clearing of the dense vegetation among the few fresh-water creeks that provide perennial haunts for *G. palpalis* should not only eliminate the localised hyperendemic areas of infection, but should bring about a total eradication of the disease in the division. Work has been begun along these lines. Considerable improvement would be expected to follow similar operations directed against perennial fly-haunts in the immediate neighbourhood of villages separated from the main river by marshes or flats and around the few wharf-towns and villages on the river banks. In the maritime region, conditions of fly dispersal and man-fly contact make the clearing of vegetation an uneconomic proposition, and there appears to be no alternative to mass chemotherapy and, perhaps, chemoprophylaxis.

Nicholas (W. L.). **The Bionomics of *Culicoides austeni*, Vector of *Acanthocheilonema perstans* in the Rain-forest of the British Cameroons, together with Notes on *C. grahamii* and other Species which may be Vectors in the same Area.**—*Ann. trop. Med. Parasit.* **47** no. 2 pp. 187–206, 10 figs., 18 refs. Liverpool, 1953.

All but the last paragraph of the following is based on the author's summary. A study of the bionomics of *Culicoides austeni* C., I. & M. was

made in the rain-forest zone of the British Cameroons [*R.A.E.*, B **42** 103] between 23rd June and 4th December 1952. Similar, but more limited, observations were also made on three other common man-biting species, *C. grahamii* Aust., *C. inornatipennis* C., I. & M. and *C. fulvithorax* (Aust.) [*cf.* **42** 168]. The conditions in which each species seeks a blood-meal and in which mating takes place were investigated, and studies were also made of the avidity with which animals other than man are attacked, of the resting-places of the flies, the development of the eggs, oviposition, hatching, the larval habitat and the length of the life-cycle from egg to emergence. The life-history of *C. austeni* and the seasonal changes in the biting habits of *C. austeni* and *C. grahamii* are also discussed.

It appeared from the results obtained that *C. austeni* bites throughout the night in fine weather. It does not bite in heavy rain, but begins to do so again soon after the rain has stopped. *C. grahamii* bites in the morning and evening in fine weather and may bite throughout the whole day in rain; it does not bite at night. In fine weather, *C. inornatipennis* bites during the evening and to a much smaller extent after dark, and *C. fulvithorax* bites during the hours of darkness. *C. grahamii*, *C. inornatipennis* and *C. fulvithorax* were found biting in small numbers in the forest canopy. *C. austeni* will readily enter buildings and pass through a sandfly-net in search of a blood-meal. The other species were only occasionally found indoors. *C. austeni* and *C. grahamii* feed readily on goats and pigs in the villages, and *C. austeni* was observed to feed avidly on a chimpanzee in the laboratory. Neither species was found to attack hens in the field, but the evidence that *C. austeni* will not do so is inconclusive.

The spermathecae of 11 out of 12 females of *C. austeni* caught while biting, or immediately afterwards, were found to contain spermatozoa. Both sexes of *C. austeni* take part in a brief flight just before darkness falls, and it is suggested that they mate at that time. There is some evidence that *C. grahamii* and *C. fulvithorax* take part in a similar flight earlier in the evening. *C. austeni* must take a blood-meal before the eggs can develop. The eggs appear to be fully developed after two days, and under laboratory conditions, wild flies oviposit on the third or fourth night after a blood-meal. Eggs appear to develop normally in flies that have been bred from larvae in the laboratory and have been given a blood-meal, but the flies do not oviposit. Adults of *C. austeni* and *C. grahamii* of both sexes and females of *C. fulvithorax* and *C. bwambanus* De Meillon were found resting amongst the dead leaves of bananas and plantains that hang down around the stem. Females of *C. austeni*, after having entered a building and fed on the inmates, may either rest on the walls while the eggs develop or may all leave during the night. Eggs of *C. austeni* that were put in water hatched on the third day after being laid. If they were kept dry, hatching was inhibited and viability was rapidly lost. Under laboratory conditions, *C. austeni*, in material from rotting banana stems, completes its life-cycle from egg to adult in 25–28 days. The biting density of *C. austeni* falls to a low level with the onset of the dry season. No such diminution was observed in the biting density of *C. grahamii*.

In his studies on the development of *Acanthocheilonema perstans* in *C. austeni*, Sharp had to give the flies a second blood-meal to keep them alive for the necessary ten days [**16** 156], but they usually received it on the third or fourth day and did not oviposit before the sixth. In the author's experiments with this species, large numbers of wild females fed and kept in tubes oviposited on the third night after the blood-meal, but all of them died on the night of oviposition. They would not feed a second time before ovipositing. If, however, *C. austeni* is a vector of *A. perstans*, it must

take a blood-meal after the filariae in it have completed their full development. Many further attempts to keep the flies alive long enough for them to feed after oviposition were unsuccessful, but eventually seven of 21 that were fed and kept in an organdie cage with a pot of rotting banana were alive on the third morning and three, which had oviposited, took another blood-meal. Evidence that *C. austeni* can feed after oviposition in the field was later obtained, as two females collected while biting were found to contain sausage-stage filariae and completely undeveloped eggs. The development of filariae in bred *C. austeni* does not inhibit the development of the egg.

Kershaw (W. E.), Lavoipierre (M. M. J.) & Chalmers (T. A.). **Studies on the Intake of Microfilariae by their Insect Vectors, their Survival, and their Effect on the Survival of their Vectors. I.** *Dirofilaria immitis* **and** *Aëdes aegypti*.—*Ann. trop. Med. Parasit.* **47** no. 2 pp. 207–224, 7 figs., 28 refs. Liverpool, 1953.

The following is mainly based on the authors' summary. The literature concerning the intake of microfilariae by their insect vectors is reviewed [*R.A.E.*, B **21** 174; **23** 282; **28** 123, etc.]. Experiments are reported in which females of *Aëdes aegypti* (L.) were fed on a dog with large numbers of microfilariae of *Dirofilaria immitis* in its blood, the size of each blood-meal was estimated by weighing, and the number of microfilariae expected to be ingested was computed from the size of the blood-meal and from the number in samples of the peripheral blood. It was found that, for all sizes of blood-meal, most of the insects took in fewer microfilariae than might be expected, though a very few took in many more. Since most of the mosquitos took moderate or small blood-meals, they generally took in small numbers of microfilariae. The number was found not to be related to the length of time spent in feeding.

The effect of the filariae on the length of life of the mosquitos was investigated under controlled conditions by following the survival rates of two groups of mosquitos, one of which had been fed on an uninfected dog and the other on a dog with large numbers of microfilariae in the blood. It is shown that the survival rates of both groups are exponential in type, and are made up of several components. The survival rate of the uninfected mosquitos was constant and high over the first five days, constant but slightly lower from the fifth to the 12th day, and constant but still lower from the 12th to the 20th day, when the last mosquito died. Possible reasons for the occurrence of these three separate components in the survival of the uninfected mosquitos are discussed. The survival rate of the infected mosquitos was constant but very low during the first five days, constant and high from the fifth to the 20th day, and very low but constant from the 21st to the 25th day. The first of these periods corresponds to the migration of the microfilariae from the mid-gut to the Malpighian tubules, the second to the development of the larvae in the tubules, and the third to the presence of the infective forms in the haemocoele and in the head and mouth-parts. During the first five days, the infected mosquitos were dying at a rate 32 times as great as the uninfected ones. From the sixth to the 12th days, the rates of survival in the two groups were about the same.

Stueben (E. B.). **Incidence of Infection of Dogs and Fleas with** *Dirofilaria immitis* **in Florida.**—*J. Amer. vet. med. Ass.* **125** no. 928 pp. 57–60, 13 refs. Chicago, Ill., 1954.

Of 342 males and 861 females of *Ctenocephalides felis* (Bch.) collected from 71 dogs in Florida between May 1950 and July 1953, 111 and 335,

respectively, contained larvae of *Dirofilaria immitis* in advanced stages of development and many others had younger larvae. Microfilariae of *D. immitis* were found in blood smears from 89 of 142 dogs examined, and there was no evidence that dogs of different breeds or hair lengths varied in susceptibility to infection. The high proportion of dogs infected under natural conditions and the fact that fleas were often seen moving from one dog to another makes it probable that they are the natural vectors of *D. immitis*.

WEIR, H. T. **Trypan Blue and Furaspor Concentrate in the Treatment of Demodectic Mange.**—*J. Amer. vet. med. Ass.* **125** no. 928 pp. 66–67, 4 refs. Chicago, Ill., 1954.

In view of the difficulty of controlling the mange of dogs caused by *Demodex canis* Leydig and the fact that the mites can occur in the lymphatic glands [*cf. R.A.E.*, B **37** 91], the author has recently adopted a combination of internal and external treatment. It consists of intravenous injection of a 1 per cent. sterile solution of trypan blue at 1 cc. per kg. body weight up to a maximum of 20 cc. per injection and external application of furaspor concentrate (2·4 per cent. nitrofurfuryl methyl ether and 90 per cent. benzyl benzoate w.v.) diluted 1:6 in water and rubbed in with a soft brush. The injections were given daily for a week and subsequently weekly and the external applications were made daily. The treatment was applied to 35 dogs with the pustular and squamous type of demodectic mange, and all of them appeared to have been freed from the mite. They seemed to improve in general health after the third or fourth injection. A solution of B-complex vitamins was given intravenously to start each injection.

WALLACE, T. & MARTIN, J. T., Eds. **Insecticides and Colonial Agricultural Development . . . Proceedings of the Sixth Symposium of the Colston Research Society held in the University of Bristol March 23rd–27th, 1953.**—10½ × 7½ ins., x + 169 pp., frontis., text illus. London, Butterworths sci. Publ., 1954. Price £1 10s.

The papers read at this symposium were designed to present a review of recent progress and prospects in the use of insecticides in British Colonial Territories; they are printed in full, with reports of the discussions on them. Most of them are noticed elsewhere [*R.A.E.*, A **42** 404–475], but three are concerned with pests of veterinary importance.

In **Insect- and Tick-transmitted Diseases of Livestock** by Sir T. DAVEY (pp. 117–121), brief notes are given on the pathogenicity of the principal trypanosomes that infect livestock and are transmitted by tsetse or by other blood-sucking flies, and on the pathogenicity and transmission by ticks of some species of *Anaplasma*, *Theileria* and *Piroplasma* [*Babesia*]. Mention is made of the possibility of controlling diseases without the use of insecticides and of the use of drugs against the trypanosomes, but it is thought that control of the tick-borne diseases depends on control of the ticks.

The Control of Insects of veterinary Importance with special Reference to the Tsetse Fly by J. CARMICHAEL (pp. 123–128) contains a list of tick-borne diseases of cattle, horses and dogs in Africa with their vectors, and notes on the control of *Glossina* spp. by DDT and BHC applied from aircraft or in other ways. Mention is also made of tests of suitable chemicals as defoliants to deprive the flies of shade and shelter.

H. E. Harbour in **The Control of Ecto-parasites of Livestock** (pp. 129–136), deals chiefly with ticks and very briefly with sheep blowflies, as they are more difficult to control than the other common pests. Notes are also given on methods of treating livestock with insecticides by spraying, fogging and oral administration where there are objections to dipping, and reference is made to the eradication of warble-flies [*Hypoderma lineatum* (Villers) and *H. bovis* (Deg.)] in Cyprus by the application of rotenone preparations in a campaign carried out from 1939 to 1942 [*cf.* B **34** 209; **36** 93].

Papers noticed by Title only.

Weyer (F.). **Bestimmungsschlüssel für die *Anopheles*-Weibchen und -Larven in Europa, Nordafrika und Westasien.** [Keys for the Determination of Females and Larvae of *Anopheles* in Europe, North Africa and western Asia.]—*Merkbl. (med. wicht. Insekt.) Nocht-Inst. Schiffs- u. Tropenkrankh. Hamburg* no. 12, 2nd edn., 38 pp., 102 figs., 20 refs. Leipzig, 1954.

Sun (Yun-pei) & Pankaskie (J. E.). *Drosophila*, **a sensitive Insect, for the Microbioassay of Insecticide Residues.**—*J. econ. Ent.* **47** no. 1 pp. 180–181, 5 refs. Menasha, Wis., 1954. [See *R. A. E.*, A **42** 396.]

Gunther (F. A.), Kolbezen (M. J.) & Blinn (R. C.). **A preliminary Report on the colorimetric Detection of Dieldrin.**—*J. econ. Ent.* **47** no. 1 pp. 185–186. Menasha, Wis., 1954.

Bradbury (F. R.) & Standen (H.). **The colorimetric Determination of Benzene Hexachloride in Insect Tissues.**—*J. Sci. Fd Agric.* **5** no. 5 pp. 252–256, 2 graphs, 8 refs. London, 1954.

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